Panasonic

アプリケーションノート
Application note

Part No.	MN63Y1208
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1. Introduction

1.1 Purpose

This is an introduction guide for the NFC Tag LSI, which covers the following.

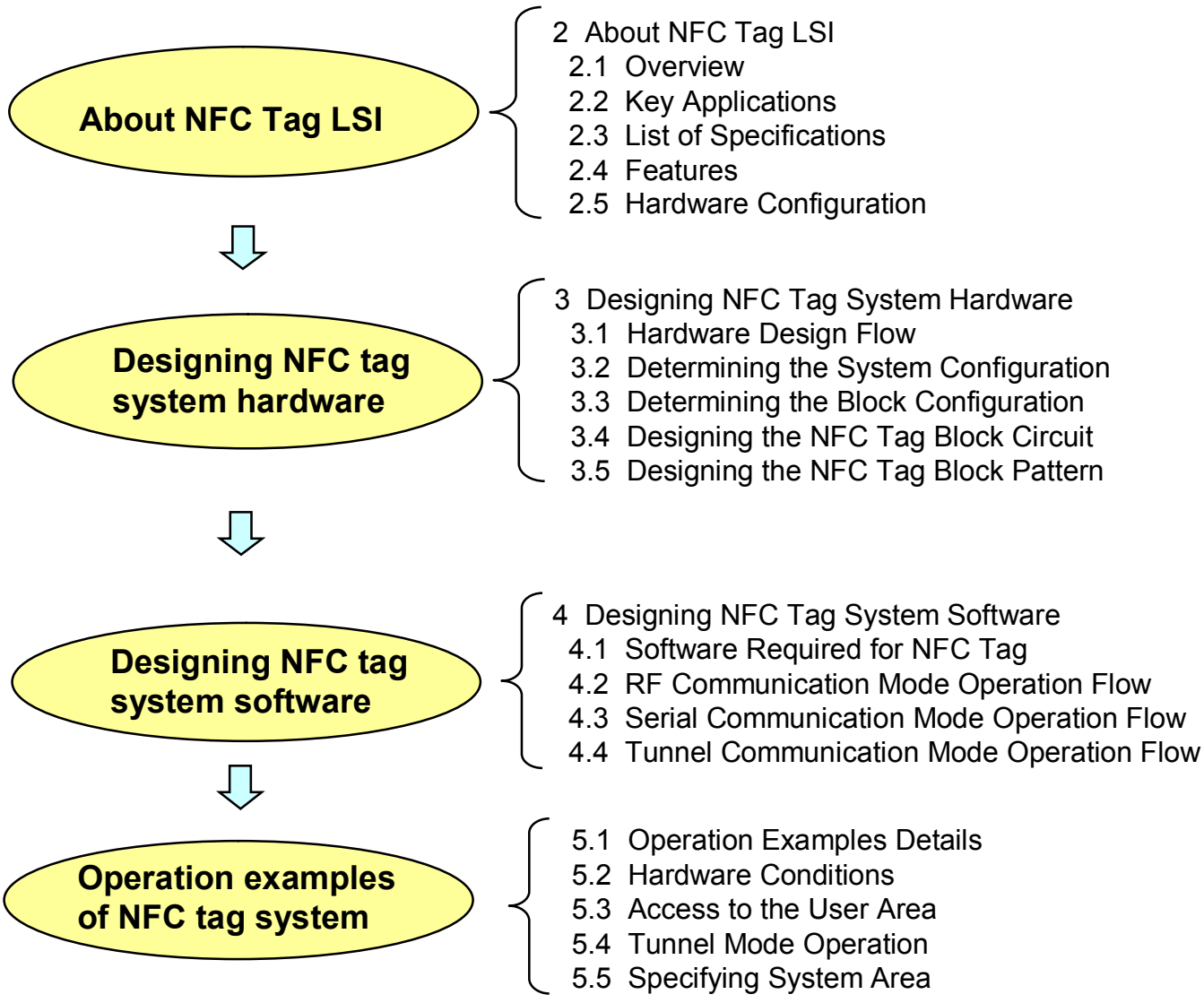
- Introduction and Overview of NFC Tag LSI
- Information necessary for setting up a system with the NFC Tag LSI

This includes typical usage examples.

When using this chip in your own environment, refer to the reference data that are introduced in this document.

1.2 Organization

This document is organized as follows:



2 About NFC Tag LSI

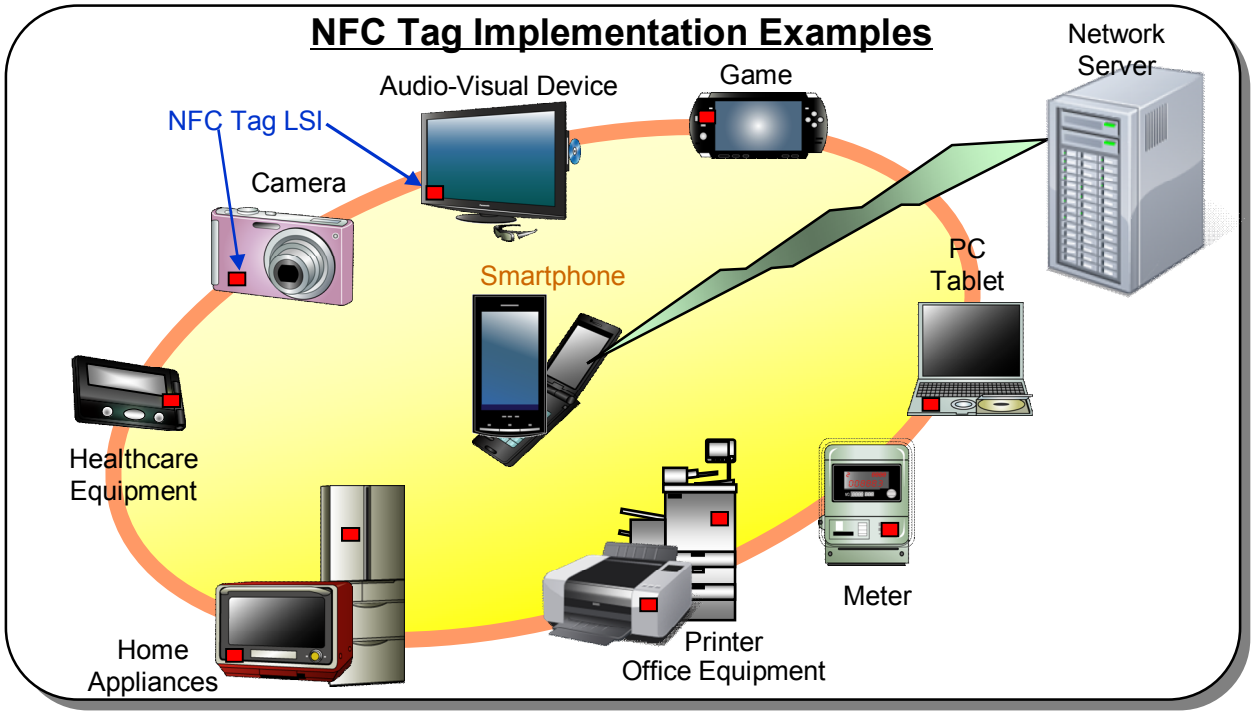
2.1 Overview

NFC-tag LSI is an NFC tag LSI, which is capable of communication with smartphone or other reader/writers.

It features built-in RF interface and wired serial interface, and includes a non-volatile memory that allows bidirectional access.

This LSI allows existing applications to easily perform RF communication.

In other words, mounting the NFC tag LSI in various applications enables them to be connected each other through NFC communication.



2.2 Key Applications

The NFC tag LSI intends for audio-visual devices, home appliances, and other applications. When this LSI is mounted in various applications, the following operations are allowed using smartphone or other reader/writers.

● Controlling home appliances and audio-visual devices from smartphone

Smartphone can read/write information from/to applications with built-in NFC tag LSI.

● When the application is in error state, the error is reported using the data stored in the built-in non-volatile memory.

This LSI's built-in non-volatile memory allows data to be read/written from/to a smartphone while the application's battery is off.

● Fast data communication with handover

Only paring is performed in NFC communication and high capacity data communication is allowed in Bluetooth and Wi-Fi.

2.3 List of Specifications

The NFC Tag LSI has a functionality optimized for RF interface implementation on applications. Its key specifications are listed in the table below.

List of Specifications

Function		NFC tag LSI	
Part No.		MN63Y1208	MN63Y1210
Package		QFN16/WLCSP	SSOP16
Operating voltage		1.7 V to 3.6 V	1.8 V to 5.5 V
Built-in non-volatile memory		4 kbits FeRAM	
RF communication	Supported communication specification	ISO/IEC14443 TYPE-B, JIS X 6319-4 (FeliCa)	
	NFC Forum tag	Type4, Type3	Type3
	Batteryless communication	Yes	
	Encryption	Yes (AES)	No
Wired communication	Interface specification	I2C (20kHz to 100 kHz)	CLK Synchronous Serial (Up to 1MHz)/ UART(Up to 38.4kbps)
	Interrupt	Yes	
RF and wired direct communications		Yes (tunnel communication mode)	

2.4 Features

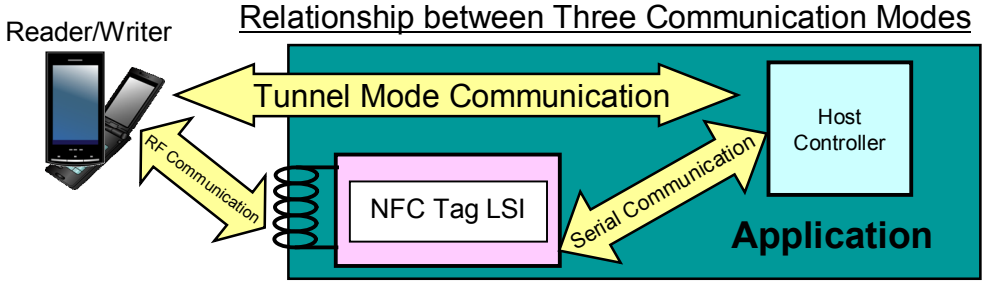
Based on the list of specifications described in Section 2.3, this section provides the features of NFC Tag LSI .

2.4.1 Three Communication Modes

The NFC Tag LSI allows itself or its application's host controller to perform the following data communications with smartphone or other reader/writers.

- RF communication mode: Reader/Writer ⇔ NFC Tag LSI
- Serial communication mode: Host controller ⇔ NFC Tag LSI
- Tunnel communication mode: Reader/Writer ⇔ Host controller

Relationship between Three Communication Modes

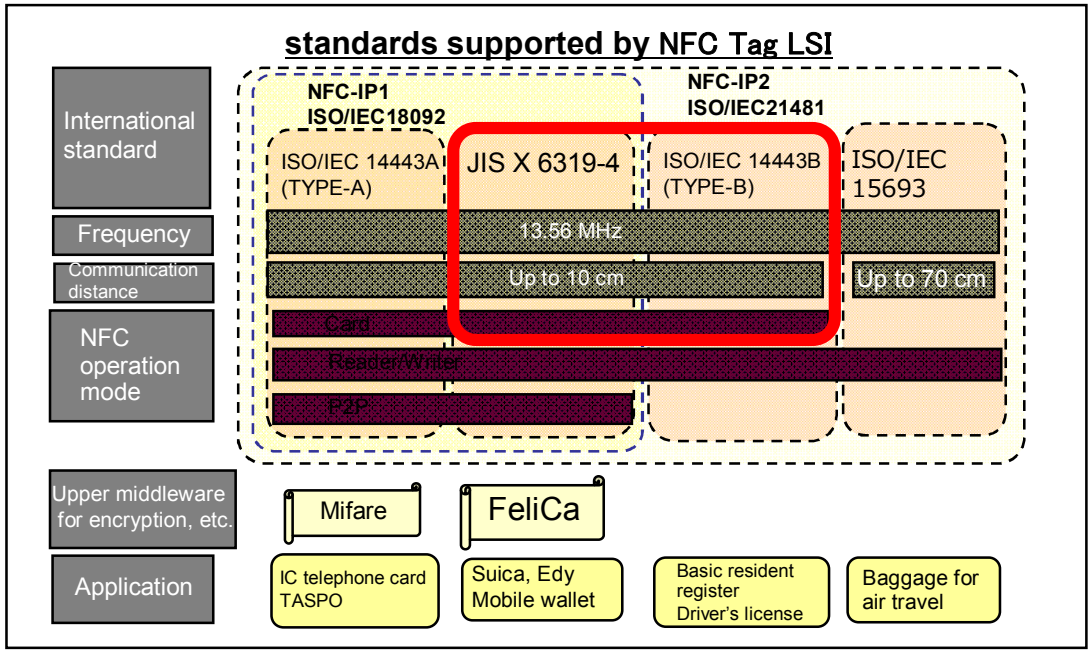


2.4.1.1 RF Communication Mode

The NFC Tag LSI supports 2 RF communication standards: ISO/IEC14443 TTPE-B and JIS X 6319-4 (FeliCa).

The standards above are typical in the world of communication, so the NFC Tag LSI supports applications for global market.

The area enclosed by a red line in the table below shows the NFC standards supported by the NFC Tag LSI .



2.4.1.2 Serial Communication Mode

The NFC Tag LSI is compatible with I2C that is typical as a serial communication interface with host controller.

The specifications of I2C supported is as follows:

Operating frequency: 100 kHz
Operating mode: Slave mode
Data format: 7-bit addressing

2.4.1.3 Tunnel Communication Mode

Operation mode used when performing direct data communication between reader/writer and application's host controller via the NFC Tag LSI .

In this mode, reader/writer accesses the virtual memory area of the host controller.

2.4.2 Functionality to Reduce Power and Utilize Interfaces Flexibly

The NFC Tag LSI has a functionality to minimize standby power and utilize both RF and serial communication interfaces flexibly.

2.4.2.1 Batteryless Communication

The NFC Tag LSI can operate as a non-volatile memory while no power is supplied from its application. (An alternating magnet field from a sender produces the power necessary for operating the LSI.)

The NFC Tag LSI can add RF communication function to applications without increasing standby power.

It can also operates even while its application's power is off.

2.4.2.2 Built-in Non-volatile Memory

The NFC Tag LSI has a built-in ferroelectric memory (FeRAM) of 4 kbits as non-volatile memory.

The memory allows for RF and serial communications with time lag.

For example, data, which is written to the NFC Tag LSI's built-in memory from a reader/writer while the application's power is off, can be read by the host controller when the application's power is turned on.

2.4.2.3 Interrupt from RF Signal

It is possible to output an interrupt signal to the host controller, based on RF signal.

This function can be used even in batteryless communication.

For example, a reader/writer can control the system's power-on wirelessly.

Interrupt signal generation conditions can be set in the NFC Tag LSI's non-volatile memory.

2.4.3 High Functionality

The NFC Tag LSI also has a functionality to meet higher usage requirements.

2.4.3.1 Encryption

RF communication is vulnerable to interception because signals travel outside of applications.

In order to address this issue, this LSI provides AES encryption for RF communication.

2.4.3.2 NDEF Format

The NFC Tag LSI supports the NDEF data format specified in the NFC Forum tag.

The support for the standard data format allows a link to certain URL and other settings for a wide variety of NFC-enabled devices.

2.5 Hardware Configuration

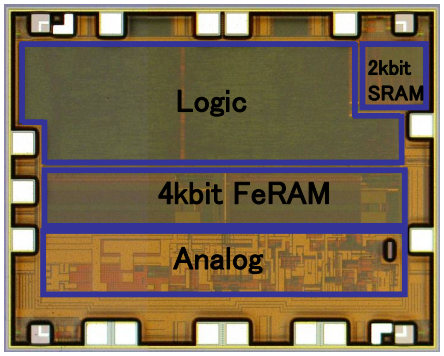
2.5.1 Internal Configuration of the LSI

The hardware of MN63Y1208 includes the following functional blocks.

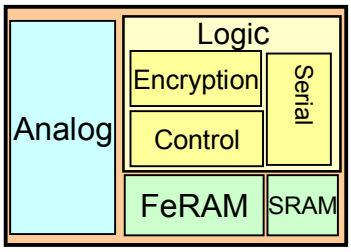
Analog block: RF interface circuit, power circuit, clock generation circuit
Logic block: Control circuit, encryption circuit, I2C interface circuit
FeRAM block: 4-kbit FeRAM (Ferroelectric memory)
SRAM block: 2-kbit SRAM

MN63Y1210 does not have encryption circuit and I2C interface circuit, but instead contains UART and CLK synchronous serial interface circuit.

Picture of MN63Y1208 Chip



NFC Tag Block

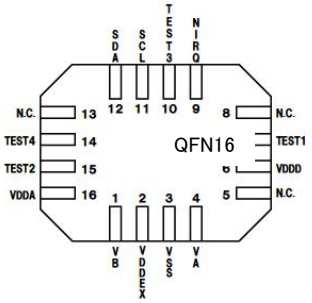


2.5.2 Pin Configuration

The pin information on MN63Y1208 and MN63Y1210 are as follows:

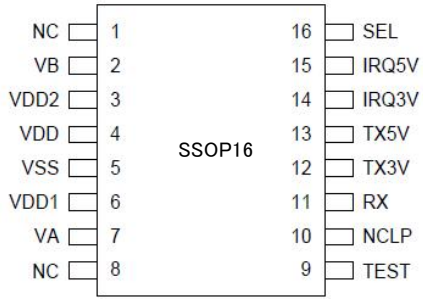
Pin configuration and package of MN63Y1208

Pin No.	Name	I/O	Output type	Description
1	VB	I/O	-	Connected to coil
2	VDDEX	-	Power	Contact power supply (Apply 1.7 V through 3.6 V.)
3	VSS	-	GND	Ground
4	VA	I/O	-	Connected to coil
5	N.C.	-	-	Not connected
6	VDDD	-	Power	Internal digital power supply (Connect a capacitor between this pin and VSS.)
7	TEST1	Input	-	Test control (Normally connected to VSS)
8	N.C.	-	-	Not connected
9	NIRQ	Output	Open Drain	Interrupt request output
10	TEST3	Input	-	Test control (Normally connected to VSS)
11	SCL	Input	-	Host interface (I2C: 100 kHz)
12	SDA	I/O	Open Drain	Host interface (I2C: 100 kHz)
13	N.C.	-	-	Not connected
14	TEST4	Input	-	Test control (Normally connected to VSS)
15	TEST2	Input	-	Test control (Normally connected to VSS)
16	VDDA	-	Power	Internal analog power supply (Connect a capacitor between this pin and VSS.)



Pin configuration and package of MN63Y1210

Pin No.	Name	I/O	5V tolerant	Output type	Description
1	NC	-	-	-	Not connected
2	VB	I/O	-	-	Connected to coil
3	VDD2	-	-	-	Internal analog power supply
4	VDD	-	-	-	Internal digital power supply
5	VSS	-	-	-	Ground
6	VDD1	-	-	-	Internal analog power supply
7	VA	I/O	-	-	Connected to coil
8	NC	-	-	-	Not connected
9	TEST	Input	No	-	Test control
10	NCLP	-	No	-	Clamp control
11	RX	Input	Yes	-	Data reception (UART: RX, Clock sync: SCK)
12	TX3V	I/O	No	Open Drain	Data reception for 3 V (UART: TX, Clock sync: I/O)
13	TX5V	I/O	Yes	Open Drain	Data reception for 5 V (UART: TX, Clock sync: I/O)
14	IRQ3V	Output	No	Open Drain	Interrupt request output for 3 V
15	IRQ5V	Output	Yes	Open Drain	Interrupt request output for 5 V
16	SEL	Input	No	-	Serial interface selection



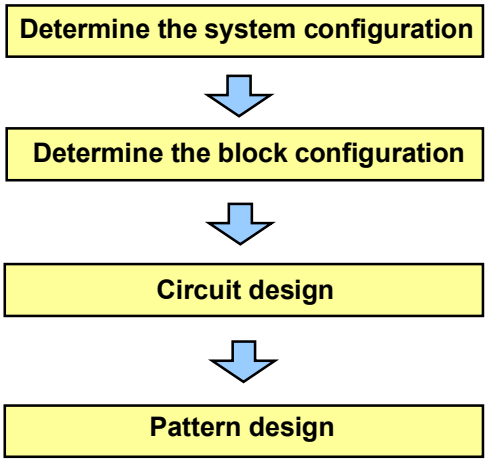
3. Designing NFC Tag System Hardware

This chapter describes the design of an NFC tag system hardware with MN63Y1208.

3.1 Hardware Design Flow

The flow of designing a hardware is summarized below.
Subsequent descriptions follow this design flow.

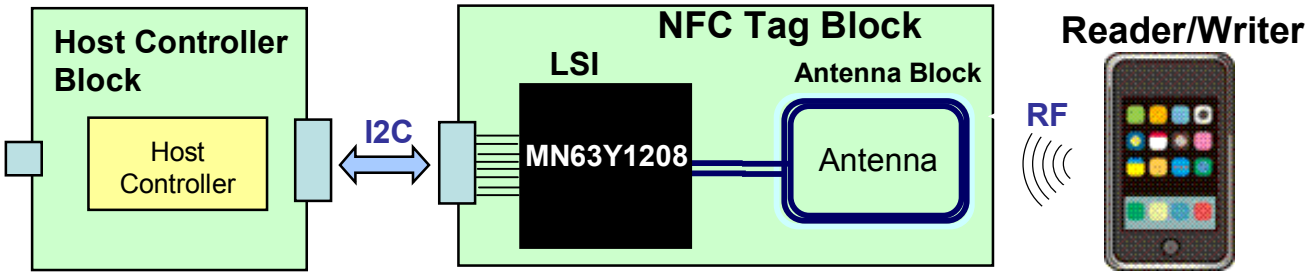
Hardware Design Flow



3.2 Determining the System Configuration

First, determine the system configuration based on requirements for NFC tag system and the communication mode of the NFC tag LSI.
A typical system configuration example used in this document is illustrated below.

NFC Tag System Configuration Example



The figure above is based on all communication modes. The blocks required vary with the communication mode used.

- I2C communication: Host control block, NFC tag block (LSI)
- RF communication: Reader/Writer, NFC tag block (LSI, antenna)
- Tunnel mode communication: Reader/Writer, host control block, NFC tag block (LSI, antenna)

3.3 Determining the Block Configuration

Next, determine the basic block configuration.
Required functions and hardware examples by block are as follows:

Required Functions and Hardware Example by Block

Block		Required Functions	Necessary Hardware
Host control		Interface voltage: 1.7 V to 3.6 V I2C communication function (100 kHz) (NFC Tag LSI power supply control signal) (Interrupt function)	Microcontroller
NFC tag	LSI	I2C signal processing, RF signal processing	MN63Y1208 tag LSI, and peripheral components
	Antenna	RF signal reception	Antenna, and capacitor for resonant frequency adjustment
Reader/Writer		NFC Forum -compliant communication	Smartphone with built-in NFC function

Host control block:
Select the controller supporting the following functions.
- I/O voltage: 1.8 V or 3.3 V
- I2C communication function
- (As needed) GPIO with a high output current capacity of at least 500 μA for battery off
- (As needed) interrupt function for detecting interrupt from RF signal

LSI of NFC tag block:
NFC tag LSI and peripheral components are required.
For more information, see Section 3.4.

Antenna of NFC tag block:
Adjusted antenna and resonant capacitor are required.
For more information, see the separate Antenna Design Guide.

Reader/Writer:
Reader/Writer for NFC communication

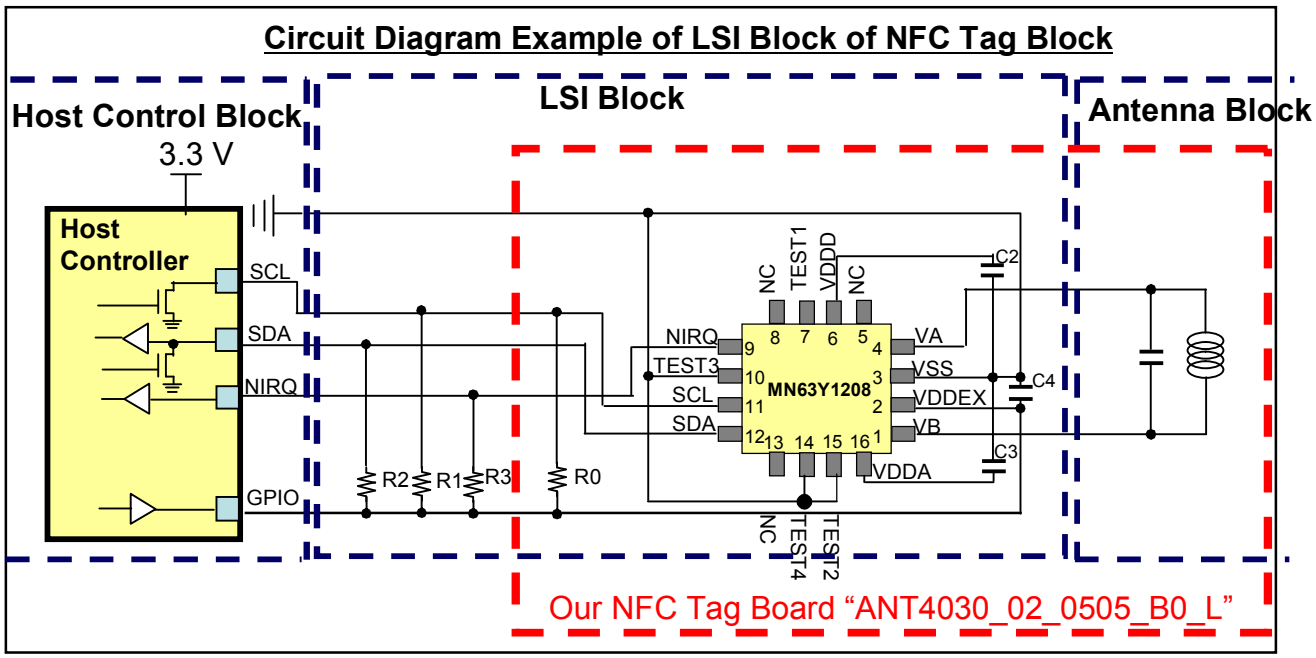
For Reference:

We provide a demonstration environment, in which block configuration is as follows:
- Host control block: Host board with our on-board microcontroller (MN101EF63G)
- NFC tag block: ANT4030_02_0505_B0_L (our NFC tag board)
  For reference circuit, see Section 3.4.
  LSI: For more information, see Section 3.4.
  Antenna: Our antenna board for demonstration
- Application software for reader/writer: Android application software for smartphone

3.4 Designing the NFC Tag Block Circuit

A circuit diagram example using MN63Y1208 is shown below.
For information about antenna block, see the separate Antenna Design Guide.
For information about connections, see the figure below.
For information about the tag LSI's peripheral components, see the table below.

Circuit Diagram Example of LSI Block of NFC Tag Block



NFC Tag LSI's Peripheral Components

External Components	Recommended Value	Description
R1, R2	3.3 kΩ	Pullup resistors for I2C signal line Determine the values based on data rate, wiring capacitance, and current capacity. Unmounted on our NFC tag board "ANT4030_02_0505_B0_L."
R3	3.3 kΩ	Pullup resistor for interrupt signal line Determine the values based on wiring capacitance and current capacity. Unmounted on our NFC tag board "ANT4030_02_0505_B0_L."
C2, C3, C4	0.1 μF	Capacitors between power supplies for stabilizing the tag LSI operation. Their values are fixed. C2 is connected to VDDD; C3 to VDDA, C4 to VDDEX.
R0	100 kΩ	Pullup resistor to prevent the undefined state of SCL leading to malfunction. Necessary when R1 is connected to the NFC tag LSI.

Note: R1, R2, and R3 on the tag LSI's peripheral circuit is unnecessary for RF communication. When using our NFC tag board "ANT4030_02_0505_B0_L," mount these resistors on the host control block side of the board.

3.5 Designing the NFC Tag Block Pattern

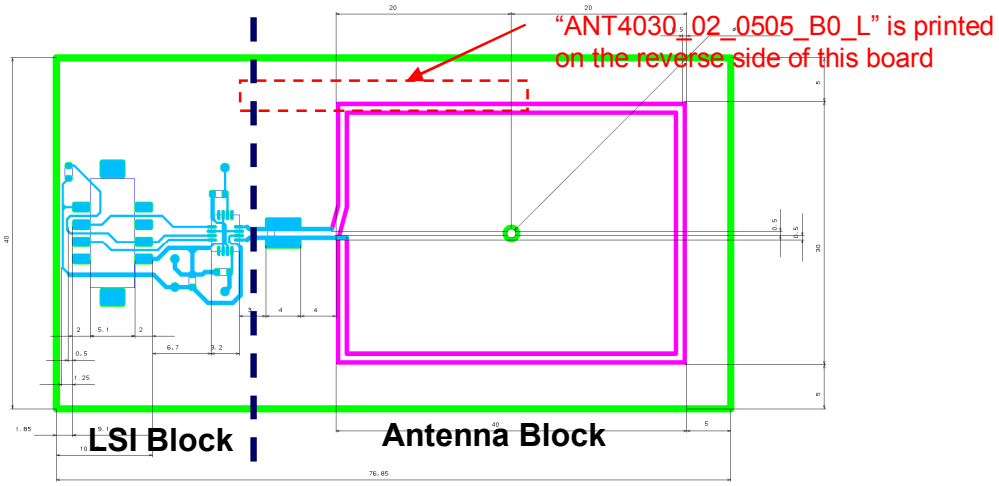
In designing a pattern of the NFC tag block, the antenna block and LSI block must be combined. This section describes the LSI block.
For information on the antenna block, see the separate Antenna Design Guide.

When designing a pattern of the LSI block, keep in mind the following precautions.

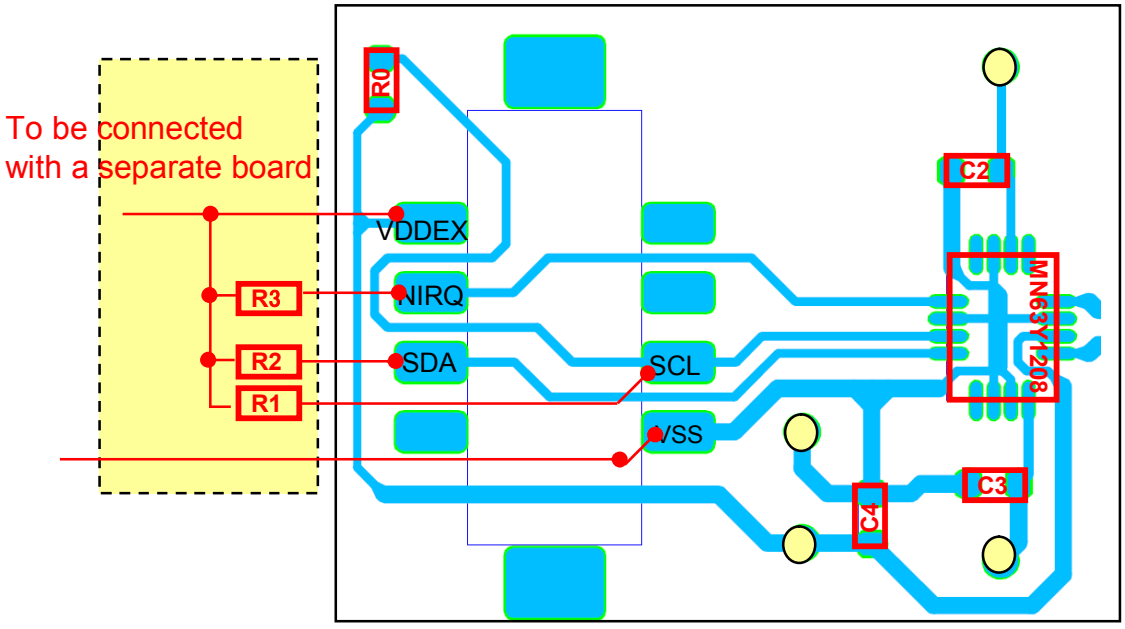
- Place capacitors C2, C3, and C4 within 20 mm from the chip.
  (For resistors R1, R2, and R3, there is no problem to exceed this limit.)

An example of the pattern for the NFC tag evaluation board "ANT4030_02_0505_B0_L" we provide is shown below.

NFC Tag Pattern Example "ANT4030_02_0505_B0_L"

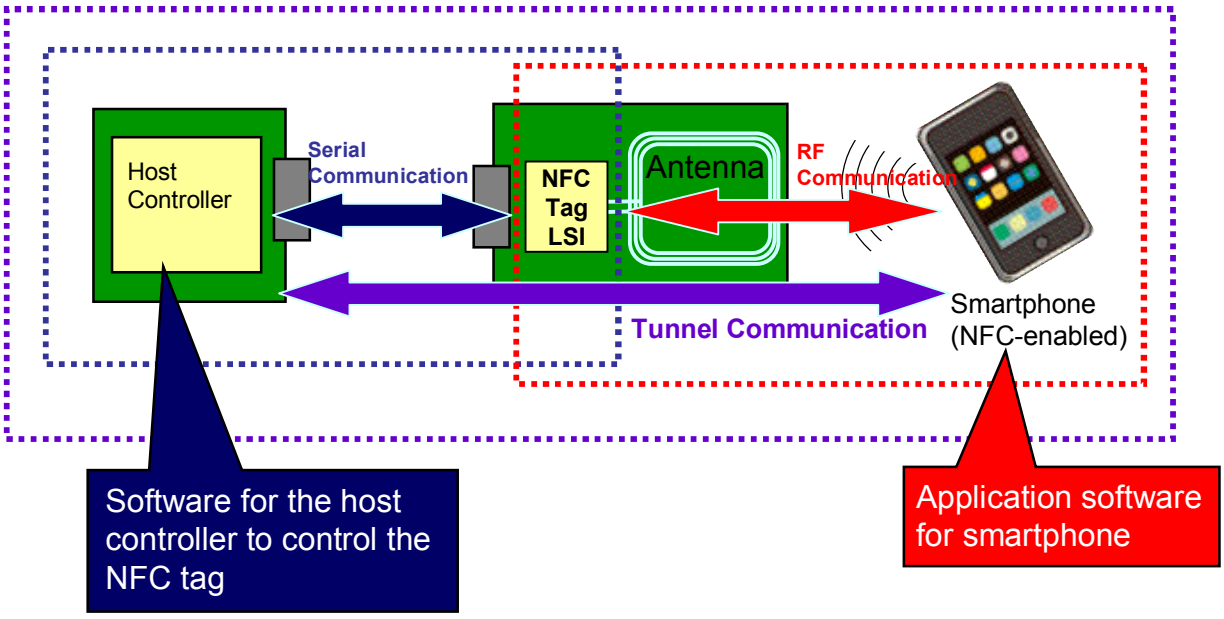


Enlarged LSI Block



4. Designing NFC Tag System Software

4.1 Software Required for NFC Tag

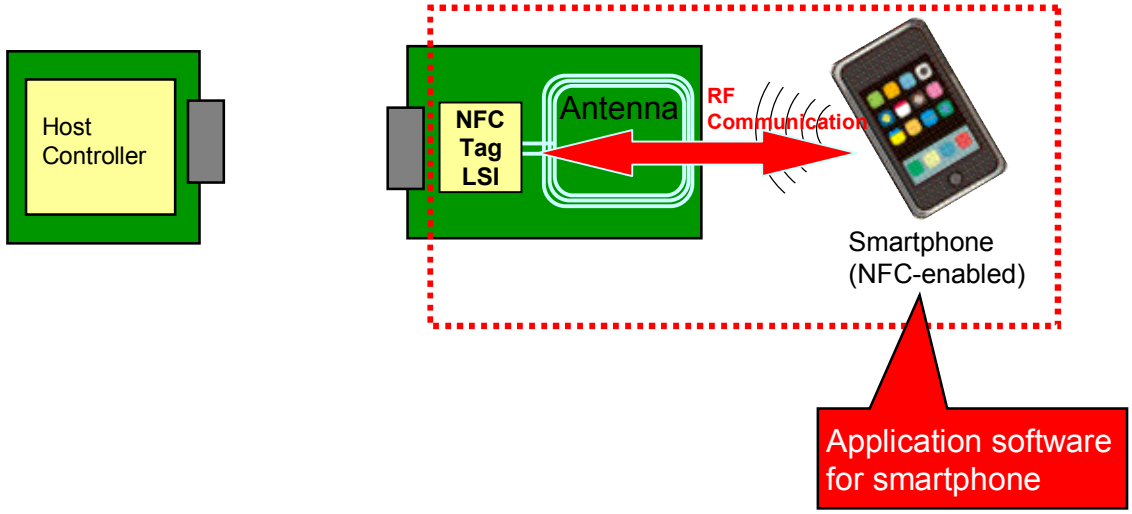


To operate an NFC tag, a software for the host controller to control the NFC tag and an application software for smartphone (Reader/Writer) are required.

The NFC tag system has 3 communication modes, each of which requires different software.

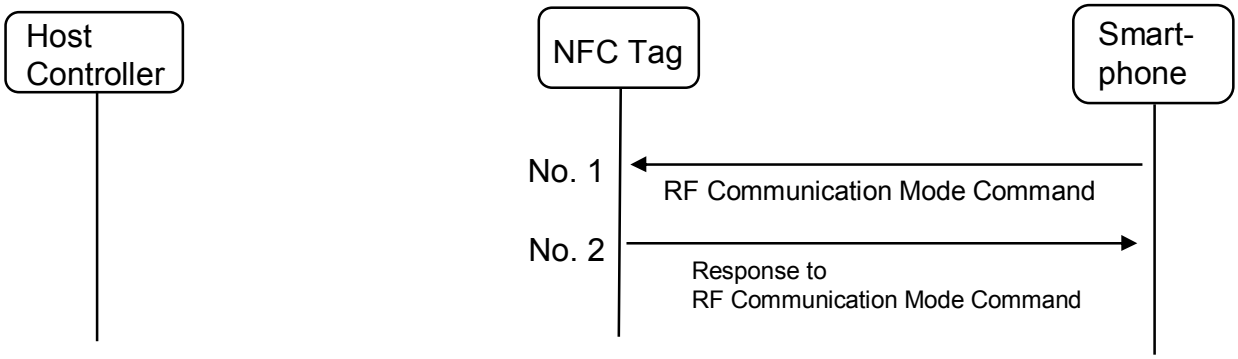
RF communication mode: Application software for smartphone
See Section 4.2.
Serial communication mode: Software for the host controller to control the NFC tag
See Section 4.3.
Tunnel communication mode: Both software described above
See Section 4.4.

4.2 RF Communication Mode Operation Flow



In RF communication mode, even if no voltage is supplied to the NFC tag LSI, generating a magnetic field from a smartphone (Reader/Writer) activates the NFC tag, allowing the smartphone to access the NFC tag LSI's built-in FeRAM.

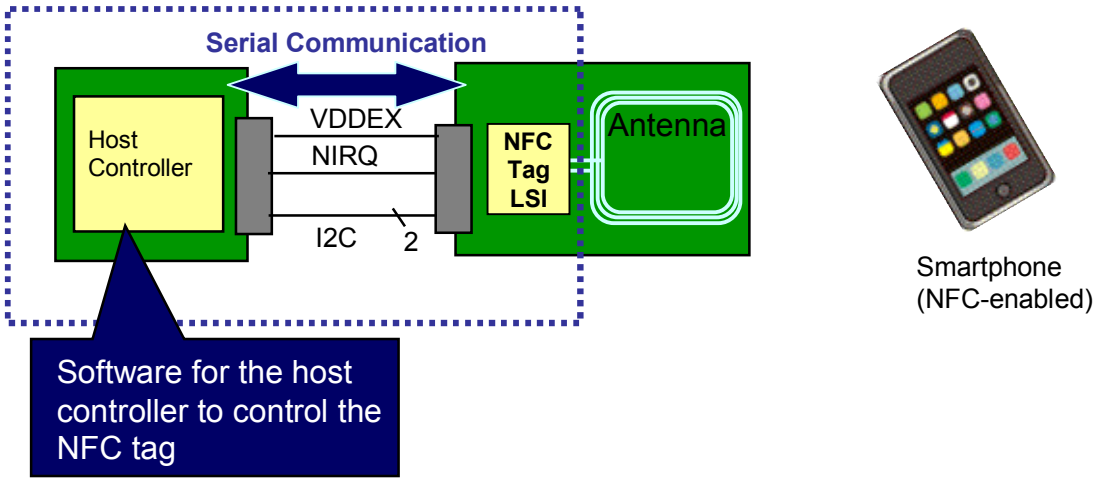
The figure below illustrates the operation flow of the smartphone and the NFC tag.



No. 1: Smartphone sends an RF communication mode command to the NFC tag.
No. 2: The NFC tag receives the RF communication mode command sent in Step No. 1, process it in the tag LSI, and then sends the processing results to the smartphone as a response to the RF communication mode command.

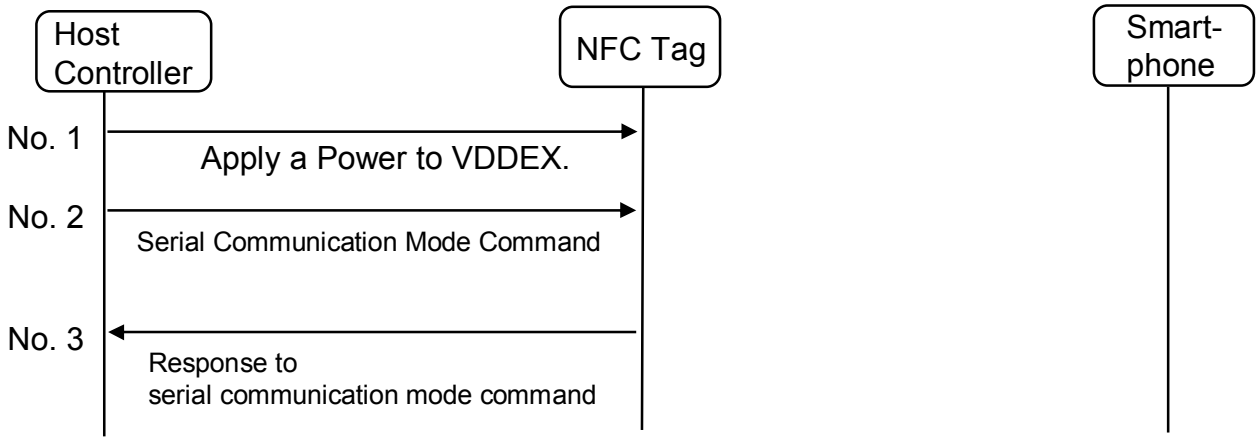
We provide sample demonstration application software for smartphone.
For detailed settings and operations, refer to the source code of the sample software.
In addition, for an outline of how to use the sample demonstration software, see the Appendix.

4.3 Serial Communication Mode Operation Flow



In serial communication mode, supplying a power from the host controller activates the NFC tag, allowing the host controller to access the NFC tag LSI's built-in FeRAM.

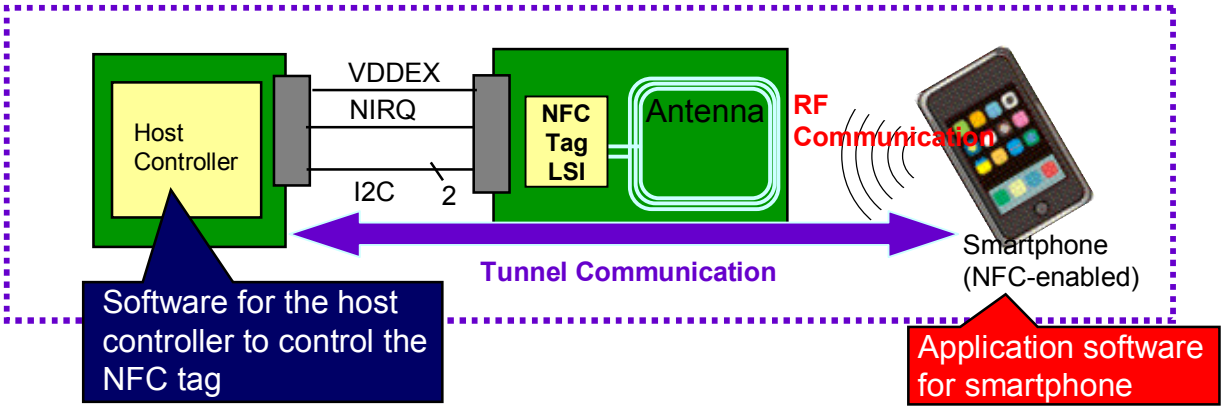
The figure below illustrates the operation flow of the host controller and the NFC tag.



No.1: Apply a power to VDDEX pin and then wait at least 3 ms for a serial communication mode command to be issued in Step No. 2. (See parameter E1 of the Product Standards.)
No.2: The host controller sends an serial communication mode command to the NFC tag.
No.3: The NFC tag receives the serial communication mode command sent in Step No. 2, process it in the NFC tag LSI, and then sends the processing results to the host controller as a response to the serial communication mode command.

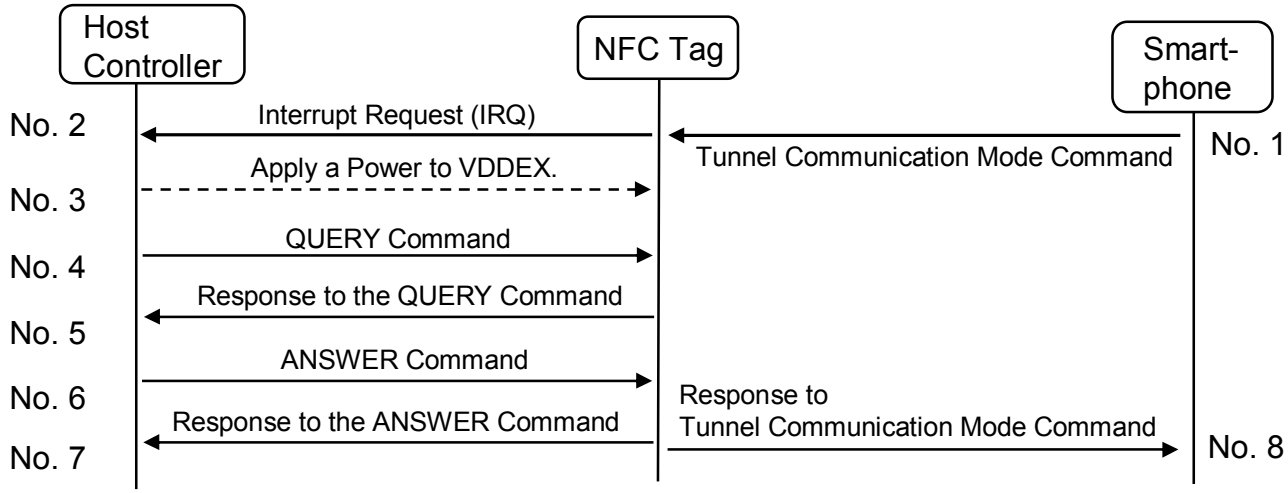
We provide sample demonstration software for host controller.
For detailed settings and operations, refer to the source code of the sample software.
In addition, for an outline of how to use the sample demonstration software, see the Appendix.

4.4 Tunnel Communication Mode Operation Flow



Using the tunnel communication mode allows communication between the host controller and a smartphone via the NFC tag, however requiring the following: software for the host controller and application software for smartphone.

The figure below illustrates the operation flow in tunnel communication mode.



No. 1: Smartphone sends a tunnel communication mode command to the NFC tag.
No. 2: The NFC tag receives the tunnel communication mode command and then sends an Interrupt request (IRQ) to the host controller.
No. 3: When a power is not applied to VDDEX pin, the host controller applies it to the pin.
No. 4: The host controller sends a QUERY command to the NFC tag.
No. 5: The NFC tag sends a response to the QUERY command to the host controller.
No. 6: The host controller sends an ANSWER command to the NFC tag to report the results.
No. 7: The NFC tag receives the ANSWER command and then sends a response to the command to the host controller.
No. 8: Following the response in Step No. 7, the NFC tag sends the content of the ANSWER command to smartphone as a response to the tunnel communication mode command.

We provide sample demonstration software for host controller and sample demonstration application software for smartphone. For detailed settings and operations, refer to the source code of the sample software. In addition, for an outline of how to use those software, see the Appendix.

5. Operation Examples

This chapter specifically describes the operations of a system with NFC tag, which uses hardware described in Chapter 3 and software described in Chapter 4.

Unless otherwise specified, MN63Y1208 is used for these examples.

5.1 Operation Example Details

To describe the operation examples, the following sections are provided.

- 5.3 Access to the User Area
  Access from host controller (serial) and smartphone (FeliCa, TYPE-B)
- 5.4 Tunnel Mode Operation
  Operation with smartphone (FeliCa, TYPE-B)
- 5.5 Specifying System Area
  Setting with host controller (serial) and smartphone (FeliCa, TYPE-B)

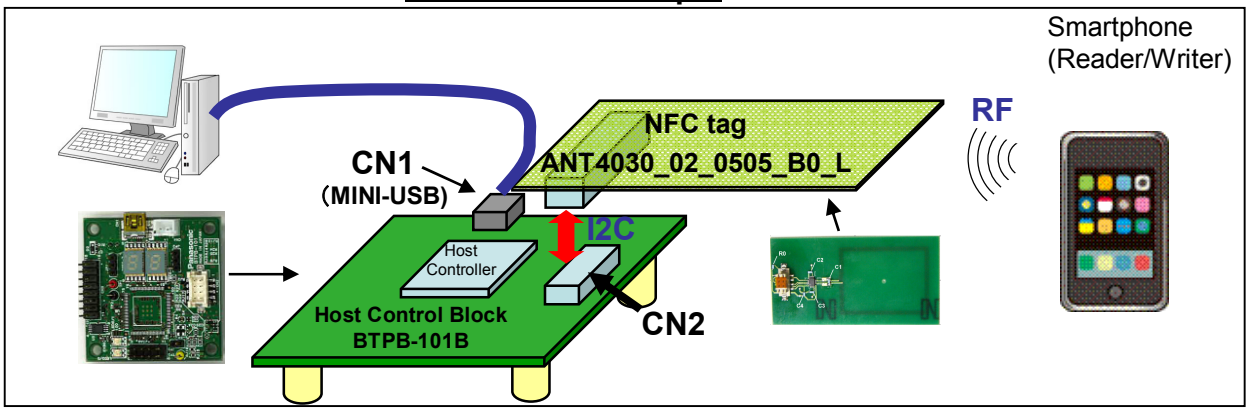
5.2 Hardware Conditions

This operation examples use the following hardware examples and connection examples.

Devices Used in this Examples

Block	Devices used	Description	Comment
Host controller	Our demonstration board: BTPB-101B	A device with built-in host controller that is accessible to NFC tag in serial communication	See the Appendix 5, “BTPB-01B Specification.”
NFC tag	Tag antenna board: ANT4030_02_0505_B0_L (With on-board MN63Y1208)	A board on which the NFC tag LSI and components for interface are implemented	See the Appendix 6 “ANT4030_02_0505_B0_ LSpecification.”
Reader/Writer	AndroidOS smartphone supporting NFC	A device to access a tag in RF communication	—

Connection Example



Reverse the ANT4030_02_0505_B0_L and connect it to the CN2 (white connector) of the BTPB-101B.

Power is supplied to the BTPB-101B through CN1.

In this demonstration environment, the PC controls the BTPB-101B to simplify the access to the NFC tag.

5.3 Access to the User Area

This section uses a simple example to describe how to access an NFC tag.

Since FeliCa uses 16 bytes, and TYPE-B and serial communication use 1 byte for each access, the following communication process is applied.

Communication Process

FeliCa	Write a data of 0xA5A5A5A5A5A5A5A5A5A5A5A5A5A5A5A5 to the block 0(the addresses of 0x000 to 0x00F) of the NFC tag. ↓ Read data from the block 0(the addresses of 0x000 to 0x00F) of the NFC tag.
Serial, TYPE-B	Write a data of 0xA5 to the address 0x0000 of the NFC tag. ↓ Read data from the address 0x0000 of the NFC tag

In the initial state of NFC tag, the following three communication modes are available: RF communication (FeliCa, TYPE-B) and serial communication. However, using the subsequent setting, you can restrict communication. In such a case, note that a certain communication may be disabled.

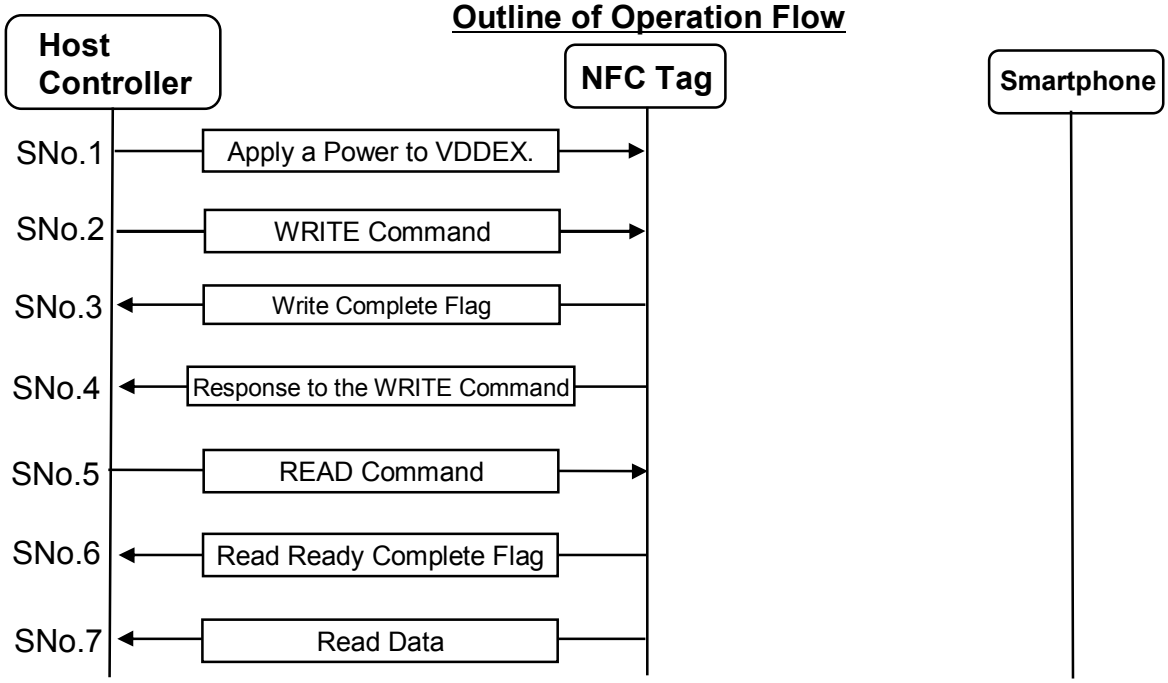
5.3.1 Access from the Host Controller (Serial)

The serial communication between the NFC tag with MN63Y1208 and the host controller is compliant with the I2C specification.

Its corresponding protocol is as follows: 7-bit addressing mode and operating frequency of 100 kHz.

The outline of the operation flow is shown in the figure below.

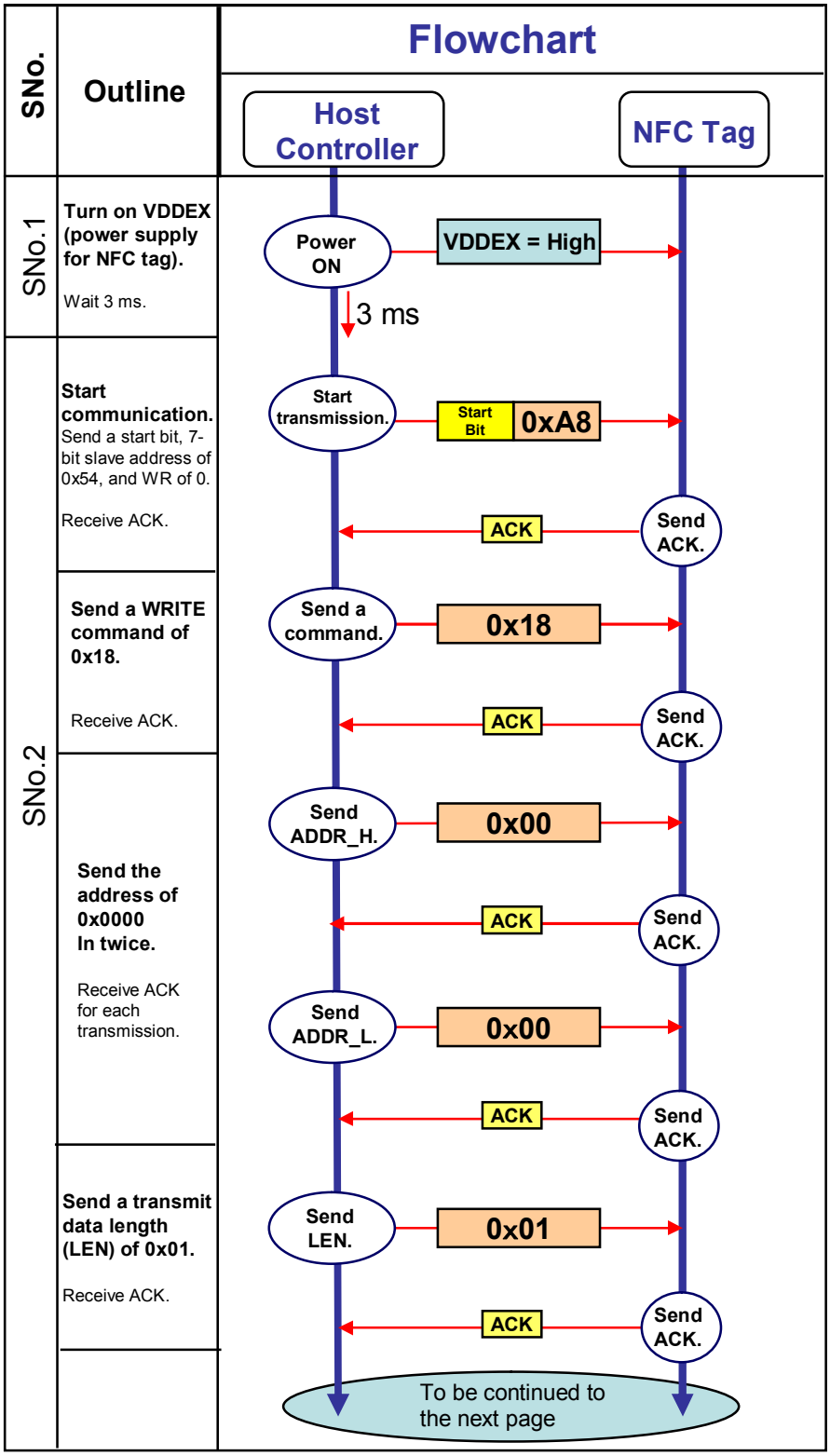
Outline of Operation Flow



SNo.1: Apply a power to VDDEX pin and then wait 3 ms for a command to be received.
(See parameter E1 of the Product Standards.)
SNo.2: The host controller sends a WRITE command to the NFC tag. After receiving the command, the NFC tag processes the command.
SNo.3: After completing the command processing, the NFC tag returns an NIRQ as a write complete flag.
SNo.4: The NFC tag sends the processing results to the host controller as a response to the write command.
SNo.5: The host controller sends a READ command to the NFC tag. After receiving the command, the NFC tag processes the command.
SNo.6: After completing the command processing, the NFC tag returns an NIRQ as a read ready complete flag.
SNo.7: the NFC tag sends a read data to the host controller as a response to the read command.

5.3.1.1 Operation Flow Details (1/3)

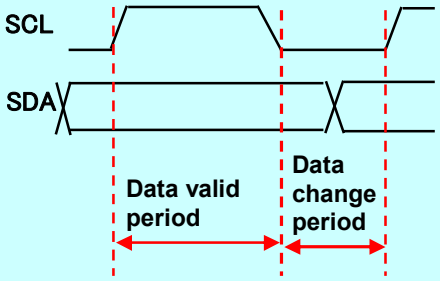
The detailed operation flow is shown in the figure below.



Comment for I2C communication

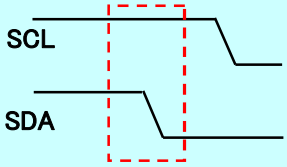
In I2C-bus communication, normally SDA is changed when SCL = low. Start bit and stop bit produce special patterns as shown below.

Normal data transmission

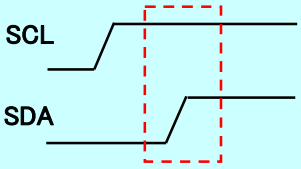


Start bit and stop bit change SDA when SLC = high.

Start bit

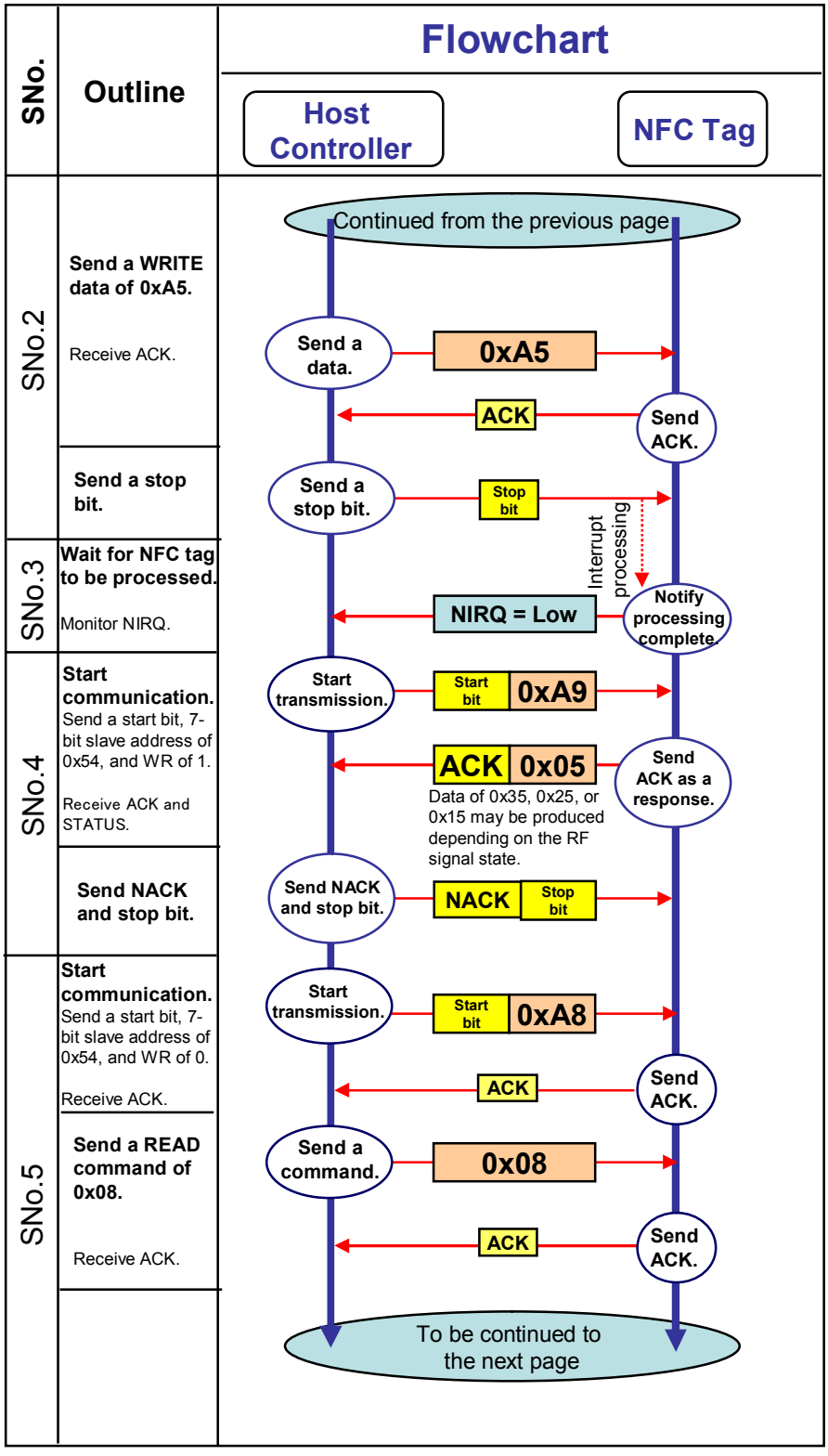


Stop bit

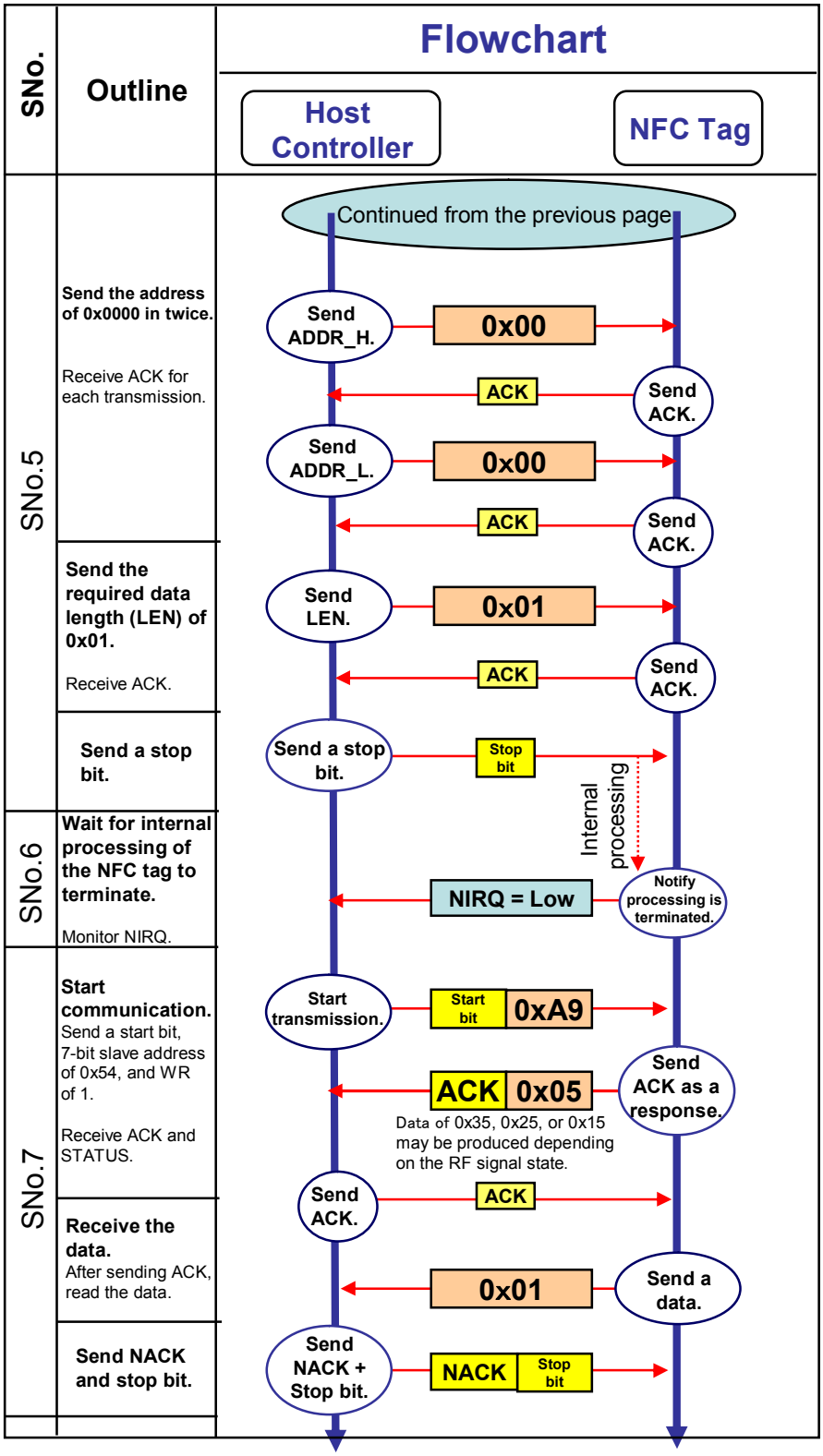


ACK: Same as data of 0
NACK: Same as data of 1

5.3.1.1 Operation Flow Details (2/3)



5.3.1.1 Operation Flow Details (3/3)



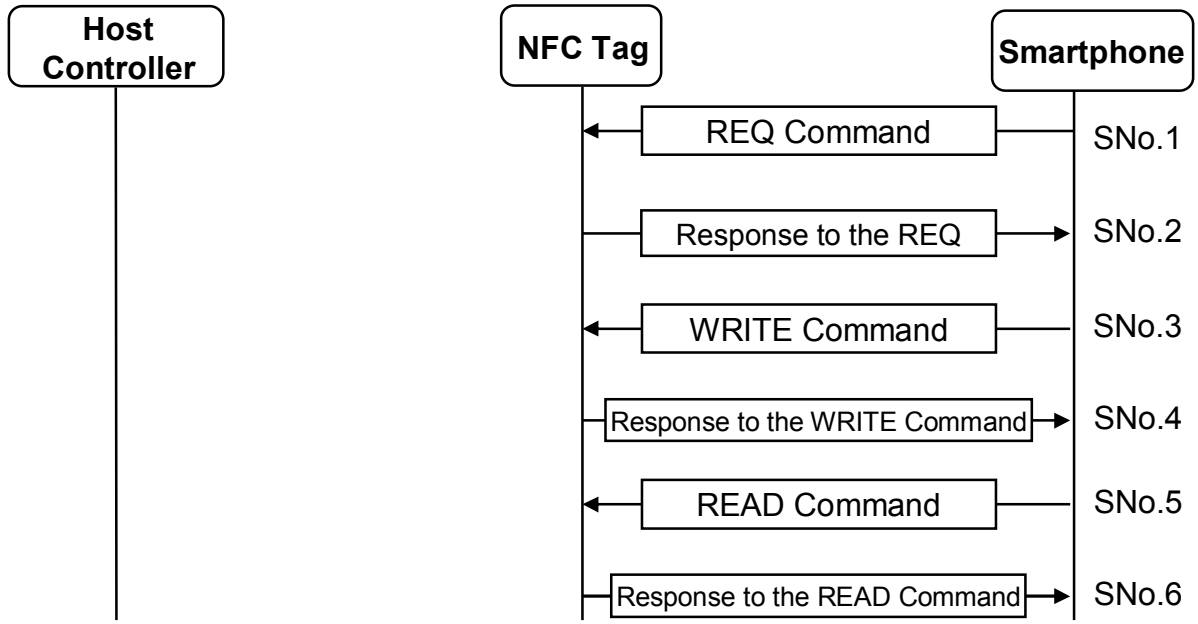
5.3.2 Access from Smartphone (FeliCa)

RF communication between smartphone (FeliCa) and NFC tag is compliant with the JISX6319-4 standard.

The data transfer rates supported are 212 kbps and 424 kbps, but anti-collision is not supported.

The outline of the operation flow is shown in the figure below.

Outline of Operation Flow

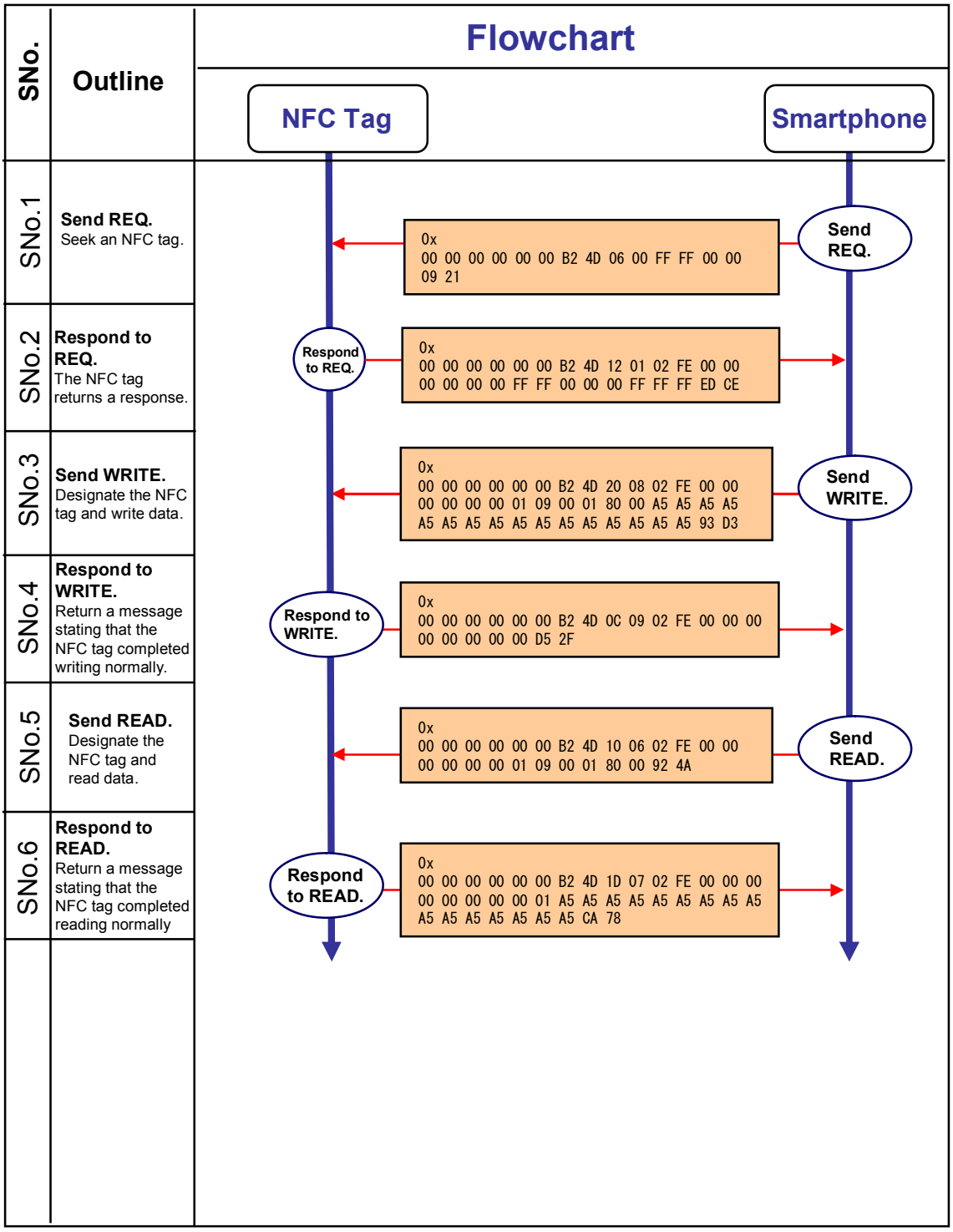


SNo.1: Smartphone sends a REQ command and waits for a response.
If NFC tag does not exist, the response to be returned in SNo.2 is not returned and SNo.1 is repeated.
SNo.2: The NFC tag returns a response to the REQ command sent in SNo.1.
The smartphone recognizes the NFC tag.
SNo.3: The smartphone sends a WRITE command.
The NFC tag receives the WRITE command and processes it.
SNo.4: The NFC tag sends the processing results to the smartphone.
SNo.5: The smartphone sends a READ command.
The NFC tag receives the READ command and processes it.
SNo.6: The NFC tag sends the read data to the smartphone.

Note: In Android terminal, the OS supports the processing of SNo. 1 and SNo. 2.

5.3.2.1 Operation Flow Details

The detailed operation flow is shown in the figure below.
For waveform specification, see the JISX6319-4 standard.



5.3.2.2 Transmission/Reception Data Details (1/3)

This section describes the transmit and receive data shown in the operation flow. For more information, see the User's Manual.

REQ

Start Field								Information Field						End Field	
PREAMBLE						SYNC CODE		LEN	CMD	SYS CODE		REQ CODE	SLOT	CRC	
00	00	00	00	00	00	B2	4D	06	00	FF	FF	00	00	09	21

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x06	Byte length of information field
CMD	Command	0x00	Code of REQ command
SYS CODE	System code	0xFFFF	Responds independent of the system area SC.
REQ CODE	Request code	0x00	Processed as "no request"
SLOT	Time slot	0x00	Always set to 00 in this LSI.
CRC	CRC calculated value	0x0921	CRC calculated value of information field

Response to REQ

Start Field								Information Field																		End Field	
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE								DATA FIELD								CRC	
00	00	00	00	00	00	B2	4D	12	01	02	FE	00	00	00	00	00	00	FF	FF	00	00	00	FF	FF	FF	ED	CE

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x12	Byte length of information field
CMD	Command	0x01	Response code to REQ
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
PMM	Response time descriptor	0xFFFF000000FFFFFF	Time until NFC tag returns a response
CRC	CRC calculated value	0xEDCE	CRC calculated value of information field

5.3.2.2 Transmission/Reception Data Details (2/3)

WRITE

Start Field								Information Field															
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE								SVS NUM	SVS		Blk NUM	Block List	
00	00	00	00	00	00	B2	4D	20	08	02	FE	00	00	00	00	00	00	01	09	00	01	80	00

~

~

																End Field	
DATA																CRC	
A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	93	D3

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x20	Byte length of information field
CMD	Command	0x08	Code of WRITE command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
SVSNUM	Number of service files	0x01	Number of service files
SVS	Service file identifier	0x0900	Service identifier
BLK NUM	Number of blocks	0x01	Number of write blocks
BLK List	Block list	0x8000	Specifies write block.
DATA	Write data	0x A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5	Write data
CRC	CRC calculated value	0x93D3	CRC calculated value of information field

Response to WRITE

Start Field								Information Field										End Field	
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE						STATUS		CRC	
																1	2		
00	00	00	00	00	00	B2	4D	0C	09	02	FE	00	00	00	00	00	00	00	00	D5	2F

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x0C	Byte length of information field
CMD	Command	0x09	Response code to WRITE command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
STATUS1	Status flag 1	0x00	00: Normal termination
STATUS2	Status flag 2	0x00	00: Normal termination
CRC	CRC calculated value	0xD52F	CRC calculated value of information field

5.3.2.2 Transmission/Reception Data Details (3/3)

READ

Start Field								Information Field														End Field
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE							SVS NUM	SVS		Blk NUM	Block List	CRC
00	00	00	00	00	00	B2	4D	10	06	02	FE	00	00	00	00	00	01	09	00	01	80	00	92	4A

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x10	Byte length of information field
CMD	Command	0x06	Code of READ command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
SVSNUM	Number of service files	0x01	Number of service files
SVS	Service file identifier	0x0900	Service identifier
BLK NUM	Number of blocks	0x01	Number of read blocks
BLK List	Block list	0x8000	Specifies read block.
CRC	CRC calculated value	0x924A	CRC calculated value of information field

Response to READ

Start Field								Information Field																									End Field
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE							STATUS		Blk NUM	DATA														CRC
00	00	00	00	00	00	B2	4D	1D	07	02	FE	00	00	00	00	00	00	00	01	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	CA	78

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x1D	Byte length of information field
CMD	Command	0x07	Response code to READ command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
STATUS1	Status flag 1	0x00	00: Normal termination
STATUS2	Status flag 2	0x00	00: Normal termination
DATA	Read data	0x A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5	Read data
CRC	CRC calculated value	0xCA78	CRC calculated value of information field

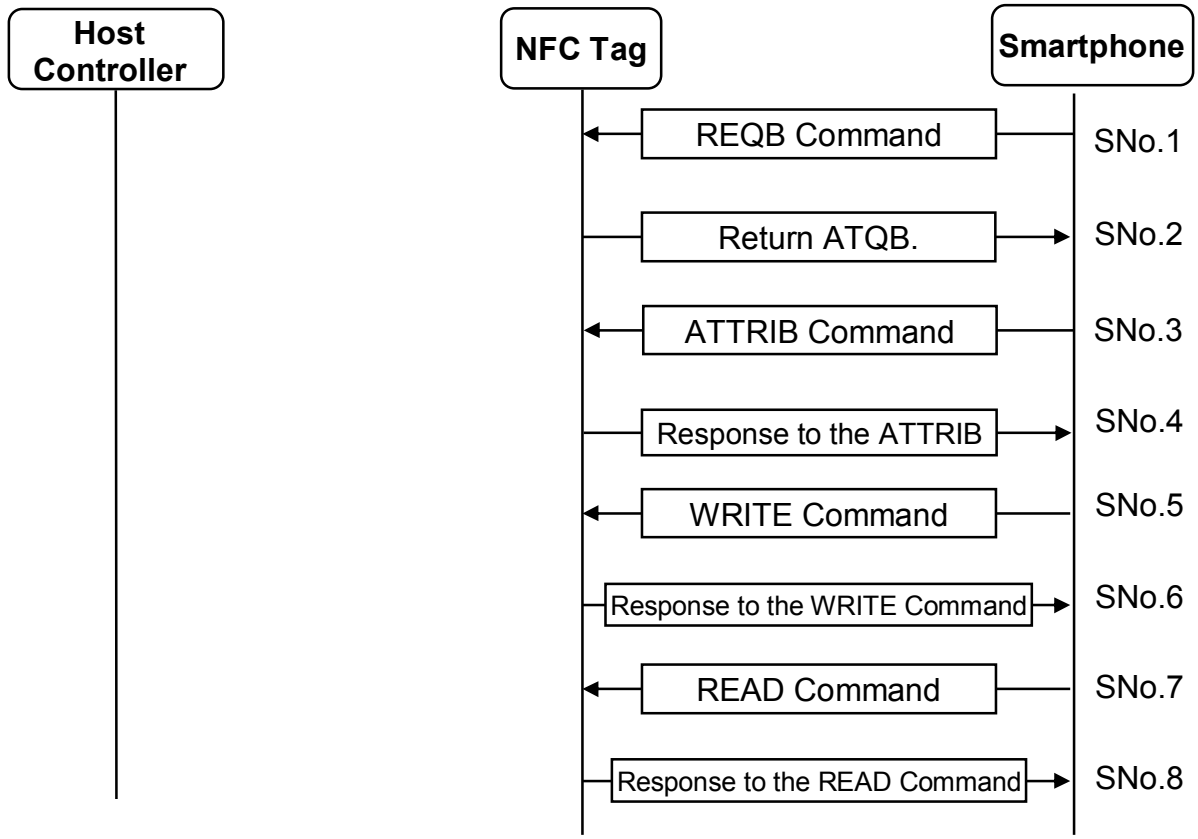
5.3.3 Access from Smartphone (TYPE-B)

RF communication between smartphone (TYPE-B) and NFC tag is compliant with the ISO/IEC14443 standard.

The data transfer rates supported are 106 kbps and 212kbps, but anti-collision is not supported.

The outline of the operation flow is shown in the figure below.

Outline of Operation Flow

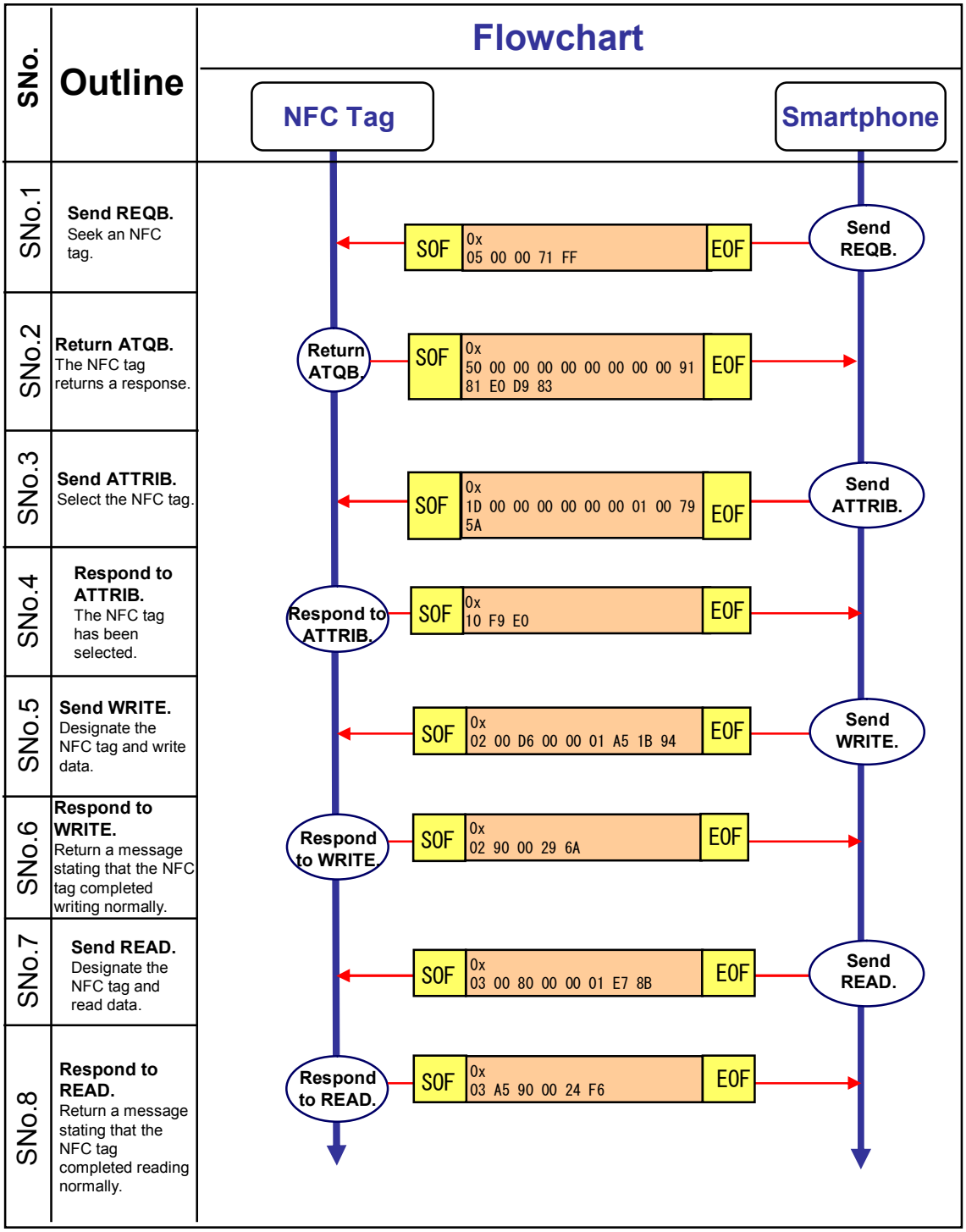


SNo.1: Smartphone sends a REQB command and waits for a response.
If NFC tag does not exist, the response to be returned in SNo.2 is not returned and SNo.1 is repeated.
SNo.2: NFC tag returns an ATQB as a response to the REQB command sent in SNo.1.
The smartphone recognizes the NFC tag.
SNo.3: The smartphone sends an ATTRIB command.
SNo.4: The NFC tag returns a response to the ATTRIB command sent in SNo.3.
The NFC tag is activated.
SNo.5: The smartphone sends a WRITE command.
The NFC tag receives the WRITE command and processes it.
SNo.6: The NFC tag sends the processing results to the smartphone.
SNo.7: The smartphone sends a READ command.
The NFC receives the READ command and processes it.
SNo.8: The NFC tag sends the read data to the smartphone.

Note: In Android terminal, the OS supports the processing of SNo. 1 to SNo. 4.

5.3.3.1 Operation Flow Details

The detailed operation flow is shown in the figure below.
For waveform specification and SOF/EOF patterns, see the ISO/IEC14443 standard.
Data is sent in units of 10 bits, to which values of 0 and 1 have been given as the first and last bits, respectively, in units of 8 bytes.
These specifications are also specified in the ISO/IEC 14443 standard.



5.3.3.2 Transmission/Reception Data Details (1/3)

REQB

SOF	CMD	AFI	PARAM	CRC		EOF
	05	00	00	71	FF	

Name	Description	Pattern	Comment
CMD	Command	0x05	REQB/WUPB command
AFI	Application Family Identifier	0x00	Overall response. See the ISO/IEC14443 standard.
PARAM	Parameter	0x00	Selects REQB.
CRC	CRC calculated value	0x71FF	CRC calculated value

ATQB (Response to REQB)

SOF	RES CODE	PUPI				Application Data				Protocol Info			CRC		EOF
	50	00	00	00	00	00	00	00	00	91	81	E0	D9	83	

Name	Description	Pattern	Comment
RES CODE	Response code	0x50	ATQB (response to REQB)
PUPI	PICC identifier	0x00000000	Lower 4 bytes of IDM
Application Data	Application Data	0x00000000	Not used
Protocol Info	Protocol Info	0x9181E0	Parameter. See the User's Manual.
CRC	CRC calculated value	0xD983	CRC calculated value

ATTRIB

SOF	CMD	Identifier				PARAM				CRC		EOF
						1	2	3	4			
	1D	00	00	00	00	00	00	01	00	79	5A	

Name	Description	Pattern	Comment
CMD	Command code	0x1D	ATTRIB command
Identifier	PICC identifier	0x00000000	Specifies the PUPI of ATQB.
PARAM1	Parameter 1	0x00	See the User's Manual.
PARAM2	Parameter 2	0x00	See the User's Manual.
PARAM3	Parameter 3	0x01	See the User's Manual.
PARAM4	Parameter 4	0x00	See the User's Manual.
CRC	CRC calculated value	0x795A	CRC calculated value

5.3.3.2 Transmission/Reception Data Details (2/3)

Response to ATTRIB

SOF	RES CODE	CRC		EOF
	10	F9	E0	

Name	Description	Pattern	Comment
RES CODE	Response code	0x10	Response to ATTRIB
CRC	CRC calculated value	0xF9E0	CRC calculated value

WRITE

SOF	PCB	CLA	INS	Address		LEN	DATA	CRC		EOF
	02	00	D6	00	00	01	A5	1B	94	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x02	I-block
CLA	CLA	0x00	Class byte; fixed value
INS	WRITE	0xD6	Instruction byte; WRITE = 0xD6
Address	Start address	0x0000	Address at which to start writes
LEN	Data length	0x01	Write data length (byte)
Data	Write data	0xA5	Write data
CRC	CRC calculated value	0x1B94	CRC calculated value

Response to WRITE

SOF	PCB	SW		CRC		EOF
		1	2			
	02	90	00	29	6A	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x02	I-block
SW1	Status word 1	0x90	0x9000: No error
SW2	Status word 2	0x00	
CRC	CRC calculated value	0x296A	CRC calculated value

5.3.3.2 Transmission/Reception Data Details (3/3)

READ

SOF	PCB	CLA	INS	Address		LEN	CRC		EOF
	03	00	B0	00	00	01	E7	8B	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x03	I-block
CLA	CLA	0x00	Class byte; fixed value
INS	READ	0xB0	Instruction byte; READ = 0xB0
Address	Start address	0x0000	Address at which to start reads
LEN	Data length	0x01	Read data length (byte)
CRC	CRC calculated value	0xE78B	CRC calculated value

Response to READ

SOF	PCB	DATA	SW		CRC		EOF
			1	2			
	03	A5	90	00	24	F6	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x03	I-block
Data	Read data	0xA5	Read data
SW1	Status word 1	0x90	0x9000: No error
SW2	Status word 2	0x00	
CRC	CRC calculated value	0x24F6	CRC calculated value

5.4 Tunnel Mode Operation

This section specifically describes how to access between the host controller and smartphone through an NFC tag while in Tunnel mode.

For information about Tunnel mode, see Section 4.4.

Since FeliCa uses 16 bytes, and TYPE-B uses 1 byte for each access, the following communication process is applied.

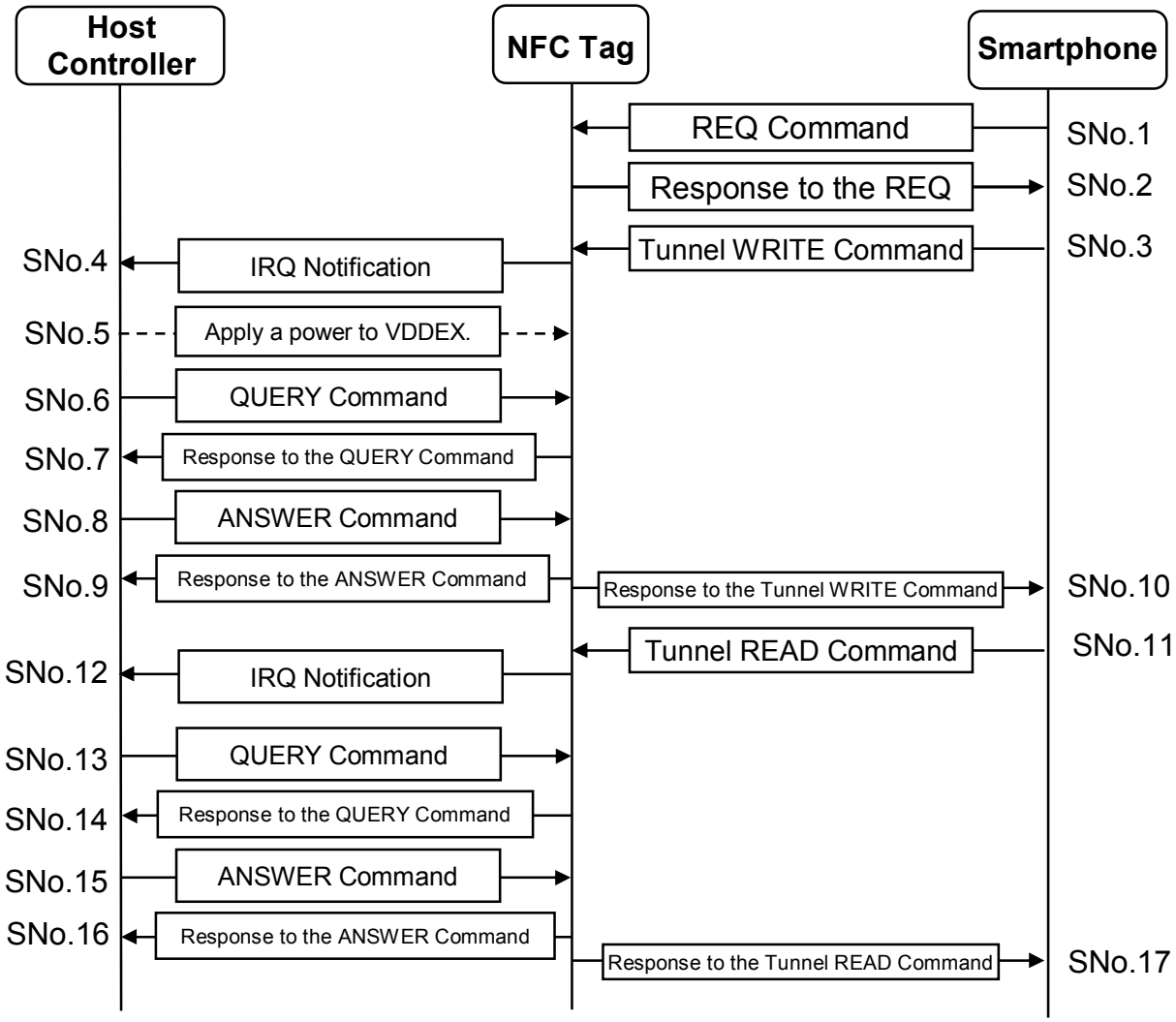
Detail of Communication

FeliCa	Write a data of 0xA5A5A5A5A5A5A5A5A5A5A5A5A5A5A5A5 to the block 0(the addresses of 0x0000 to 0x000F) of the host controller. ↓ Read data from the block 0(the addresses of 0x0000 to 0x000F) of the host controller.
TYPE-B	Write a data of 0xA5 to the address 0x0000 of the host controller. ↓ Read data from the address 0x0000 of the host controller.

In the initial state of NFC tag, the following three communication modes are available: RF communication (FeliCa, TYPE-B) and serial communication. However, using the subsequent setting, you can restrict communication. In such a case, note that a certain communication may be disabled.

5.4.1 Operation from Smartphone (FeliCa)

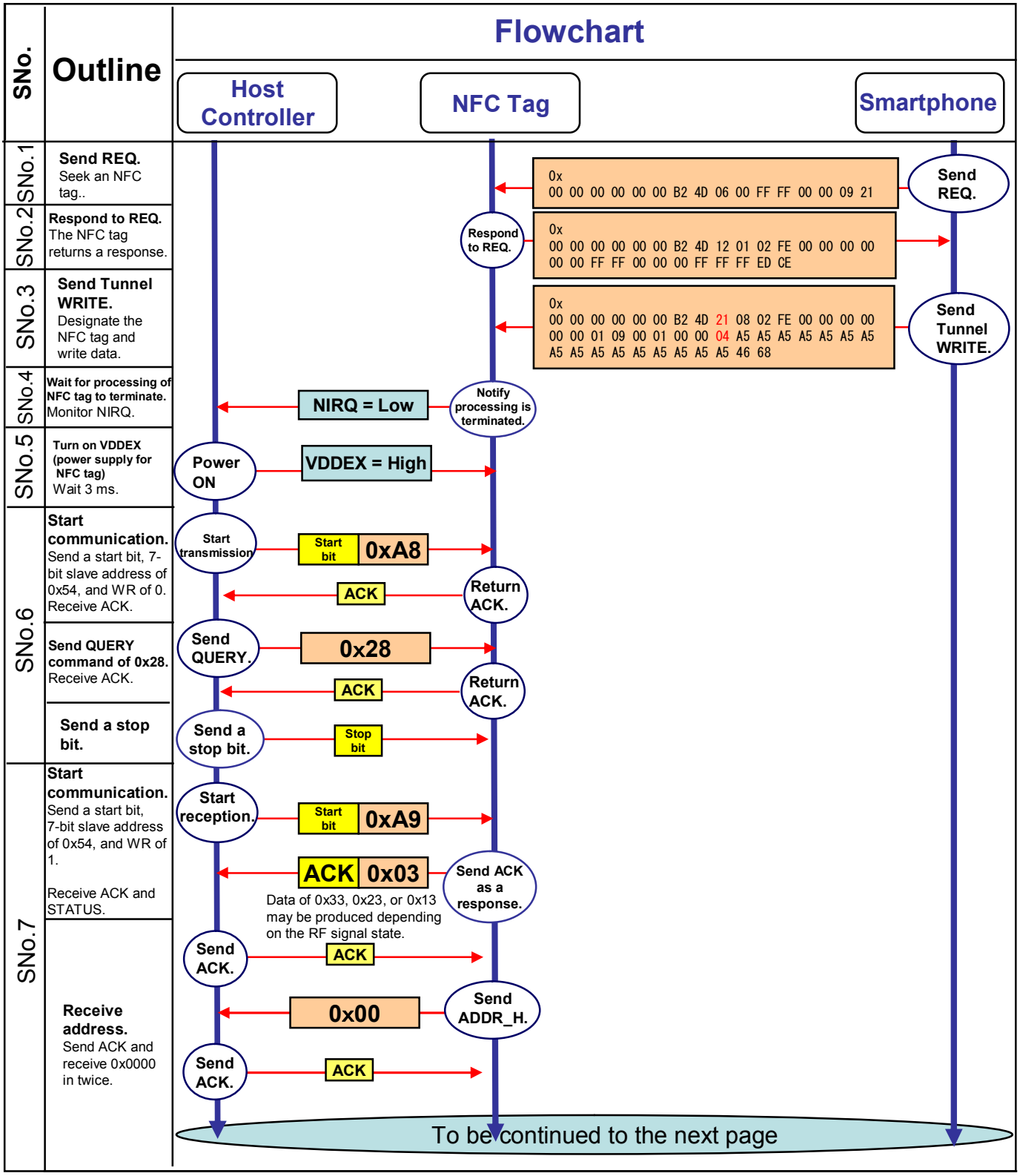
The outline of the operation flow is shown in the figure below.



SNo.1 to SNo.2: Same as for Section 5.3.2.
SNo.3: Smartphone sends a Tunnel WRITE command.
SNo.4: NFC tag notifies the host controller using NIRQ.
SNo.5: Apply a power to VDDEX pin and wait 3 ms for a command to be received.
(See parameter E1 of the Product Standards.)
SNo.6: The host controller sends a QUERY command to the NFC tag.
SNo.7: The NFC tag sends a response to the QUERY command to the host controller.
SNo.8: The host controller sends an ANSWER command to the NFC tag to report the results.
SNo.9: The NFC tag receives the ANSWER command and then sends a response to the command to the host controller.
SNo.10: The NFC tag sends a response to the Tunnel WRITE command to the Smartphone.
SNo.11: The smartphone sends a Tunnel READ command.
SNo.12 to SNo.16: Same as for SNo.4 and SNo.6 through SNo.9.
SNo.17: The NFC tag sends a response to the Tunnel READ command to the smartphone.

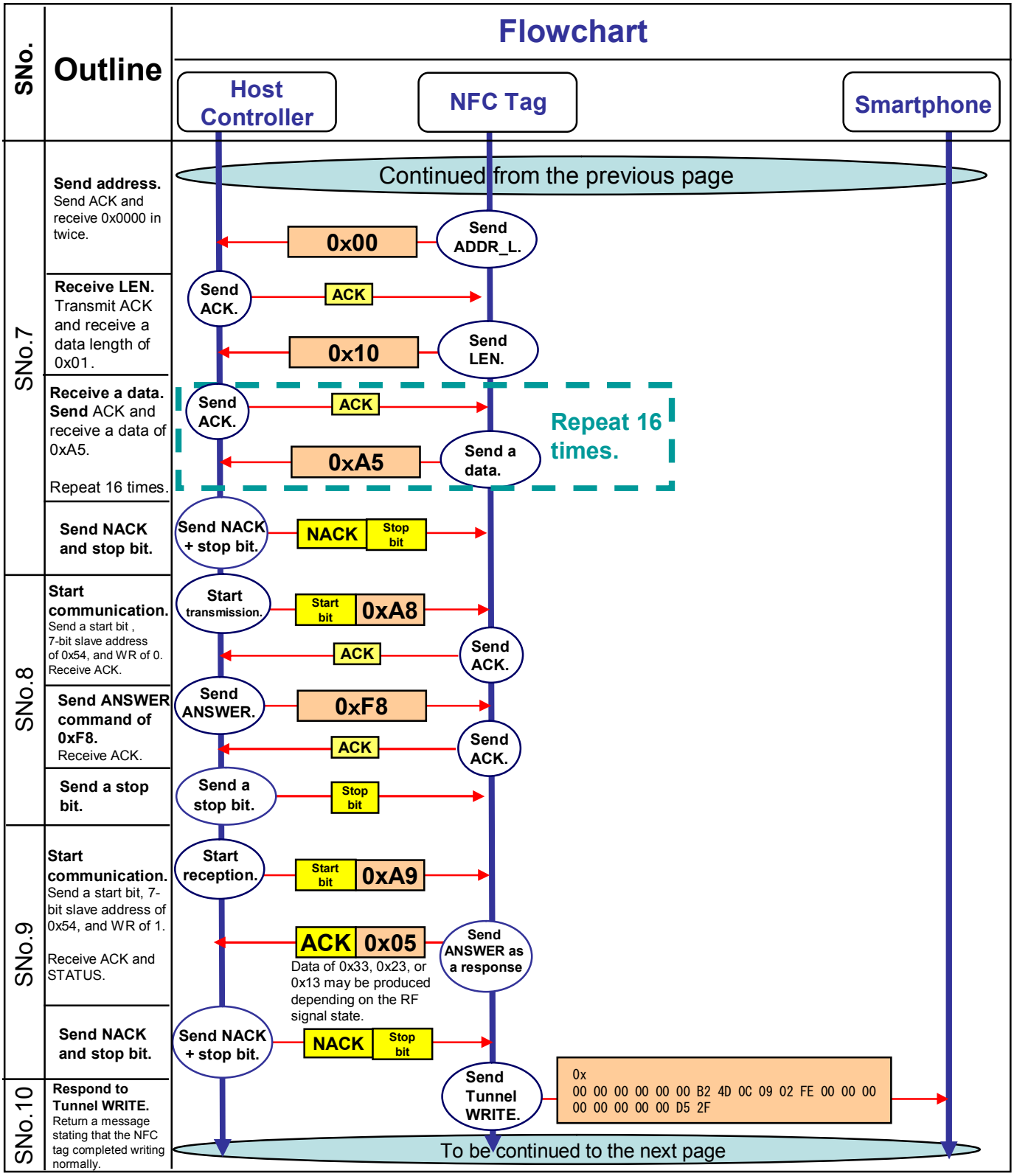
5.4.1.1 Operation Flow Details (1/4)

The detailed operation flow is shown in the figure below.



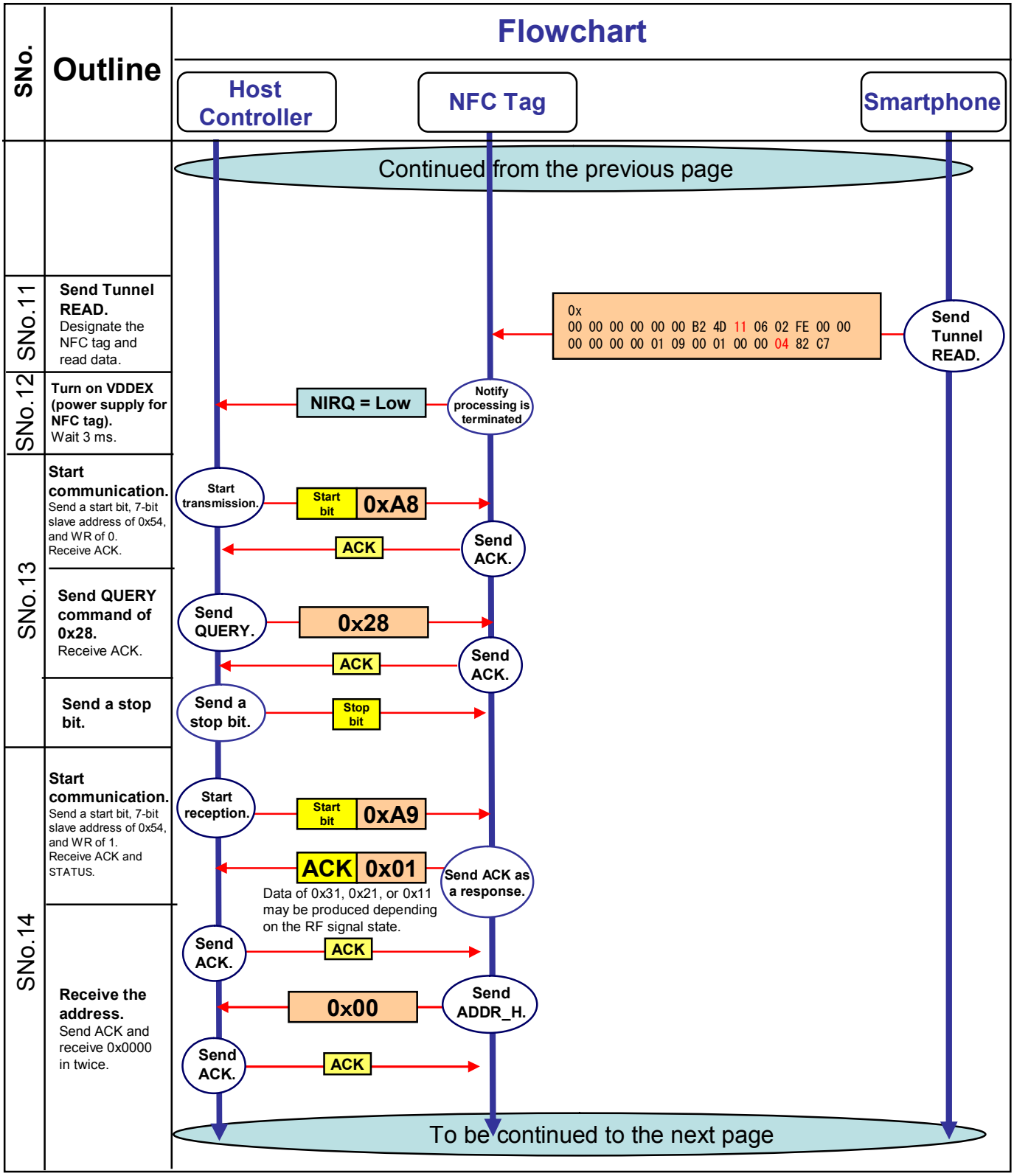
5.4.1.1 Operation Flow Details (2/4)

The detailed operation flow is shown in the figure below.



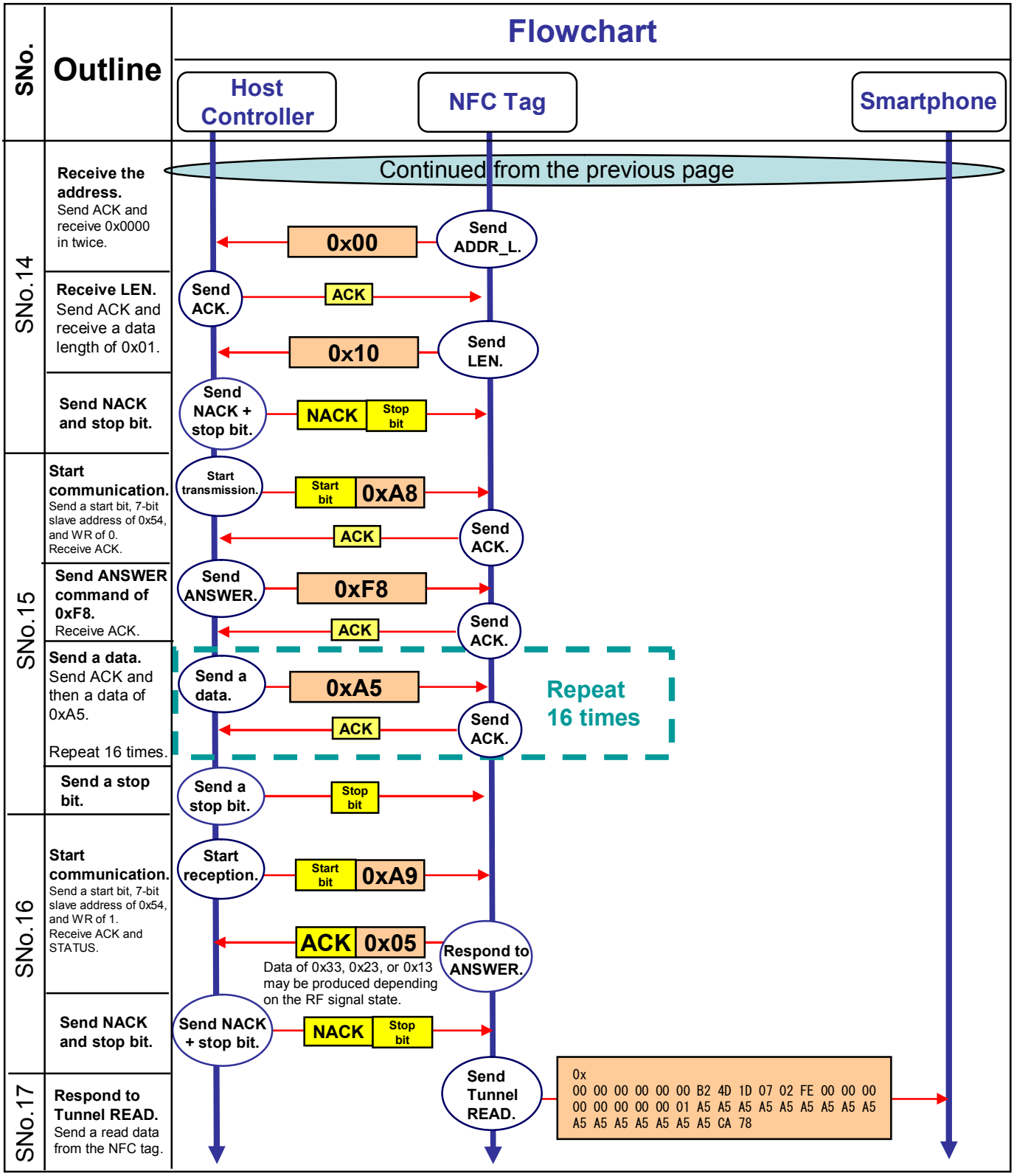
5.4.1.1 Operation Flow Details (3/4)

The detailed operation flow is shown in the figure below.



5.4.1.1 Operation Flow Details (4/4)

The detailed operation flow is shown in the figure below.



5.4.1.2 Transmission/Reception Data Details (1/3)

This section describes the transmit and receive data shown in the operation flow. For more information, see the User's Manual.

REQ

Start Field								Information Field						End Field	
PREAMBLE						SYNC CODE		LEN	CMD	SYS CODE		REQ CODE	SLOT	CRC	
00	00	00	00	00	00	B2	4D	06	00	FF	FF	00	00	09	21

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x06	Byte length of information field
CMD	Command	0x00	Code of REQ command
SYS CODE	System code	0xFFFF	Responds independent of the system area SC.
REQ CODE	Request code	0x00	Processed as "No request."
SLOT	Timeslot	0x00	Always set to 00 in this LSI.
CRC	CRC calculation value	0x0921	CRC calculated value of information field

Response to REQ

Start Field								Information Field																End Field	
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE								DATA FIELD								CRC	
00	00	00	00	00	00	B2	4D	12	01	02	FE	00	00	00	00	00	00	FF	FF	00	00	00	FF	FF	FF	ED	CE

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x12	Byte length of information field
CMD	Command	0x01	Response code to REQ
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
PMM	Response time descriptor	0xFFFF000000FFFFFF	Time until NFC tag returns a response
CRC	CRC calculated value	0xEDCE	CRC calculated value of information field

5.4.1.2 Transmission/Reception Data Details (2/3)

Tunnel WRITE

Start Field								Information Field																
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE							SVS NUM	SVS		BLK NUM	Block List			
00	00	00	00	00	00	B2	4D	21	08	02	FE	00	00	00	00	00	00	01	09	00	01	00	00	04

~

~

																End Field	
DATA																CRC	
A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	46	68

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	**0x21**	Byte length of information field; **changed in tunnel mode**
CMD	Command	0x08	Code of WRITE command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
SVSNUM	Number of service files	0x01	Number of service files
SVS	Service file identifier	0x0900	Service file identifier
BLK NUM	Number of blocks	0x01	Number of write blocks
BLK List	Block list	**0x000004**	Specifies write block. **Changed in tunnel mode.**
DATA	Write data	0x A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5	Write data
CRC	CRC calculated value	0x4668	CRC calculated value of information field

Response to Tunnel WRITE (Same Format as for Response to Normal WRITE)

Start Field								Information Field										End Field	
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE							STATUS		CRC
																	1	2	
00	00	00	00	00	00	B2	4D	0C	09	02	FE	00	00	00	00	00	00	00	D5	2F

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x0C	Byte length of information field
CMD	Command	0x09	Response code to WRITE command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
STATUS1	Status flag 1	0x00	00: Normal termination
STATUS2	Status flag 2	0x00	00: Normal termination
CRC	CRC calculated value	0xD52F	CRC calculated value of information field

5.4.1.2 Transmission/Reception Data Details (3/3)

Tunnel READ

Start Field								Information Field																End Field	
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE							SVS NUM	SVS		Blk NUM	Block List			CRC	
00	00	00	00	00	00	B2	4D	10	06	02	FE	00	00	00	00	00	00	01	09	00	01	00	00	04	82	C7

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	**0x11**	Byte length of information field; **changed in tunnel mode**
CMD	Command	0x06	Code of READ command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
SVSNUM	Number of service files	0x01	Number of service files
SVS	Service file identifier	0x0900	Service file identifier
BLK NUM	Number of blocks	0x01	Number of read blocks
BLK List	Block list	**0x000004**	Specifies read block. **Changed in tunnel mode.**
CRC	CRC calculated value	0x82C7	CRC calculated value of information field

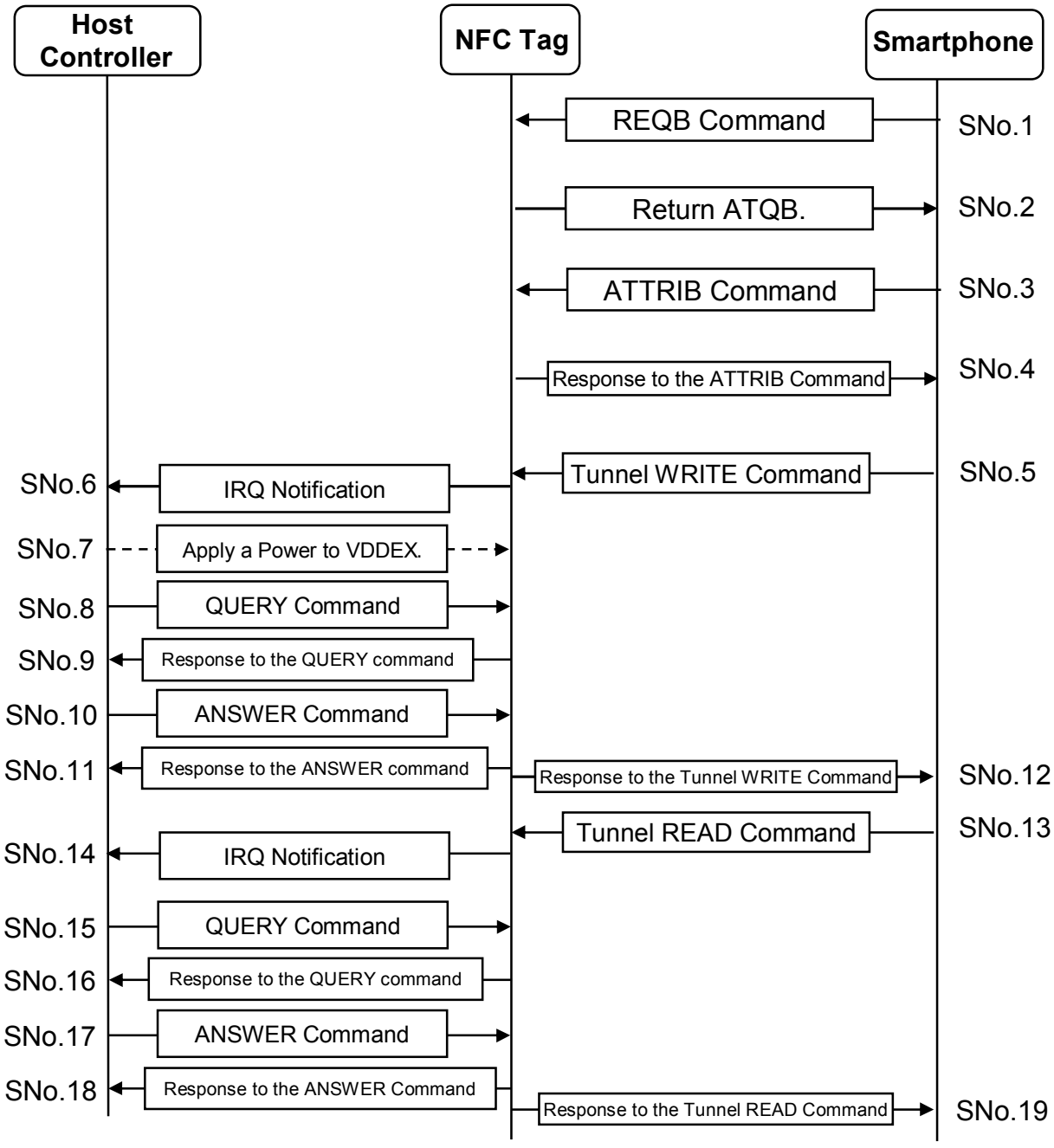
Response to Tunnel READ (Same Format as for Response to Normal READ)

Start Field								Information Field																														End Field	
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE								STATUS		Blk NUM	DATA																	CRC	
00	00	00	00	00	00	B2	4D	1D	07	02	FE	00	00	00	00	00	00	00	00	01	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	A5	CA	78

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x1D	Byte length of information field
CMD	Command	0x07	Response code to READ command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
STATUS1	Status flag 1	0x00	00: Normal termination
STATUS2	Status flag 2	0x00	00: Normal termination
DATA	Read data	0x A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5 A5	Read data
CRC	CRC calculated value	0xCA78	CRC calculated value of information field

5.4.2 Operation from Smartphone (TYPE-B)

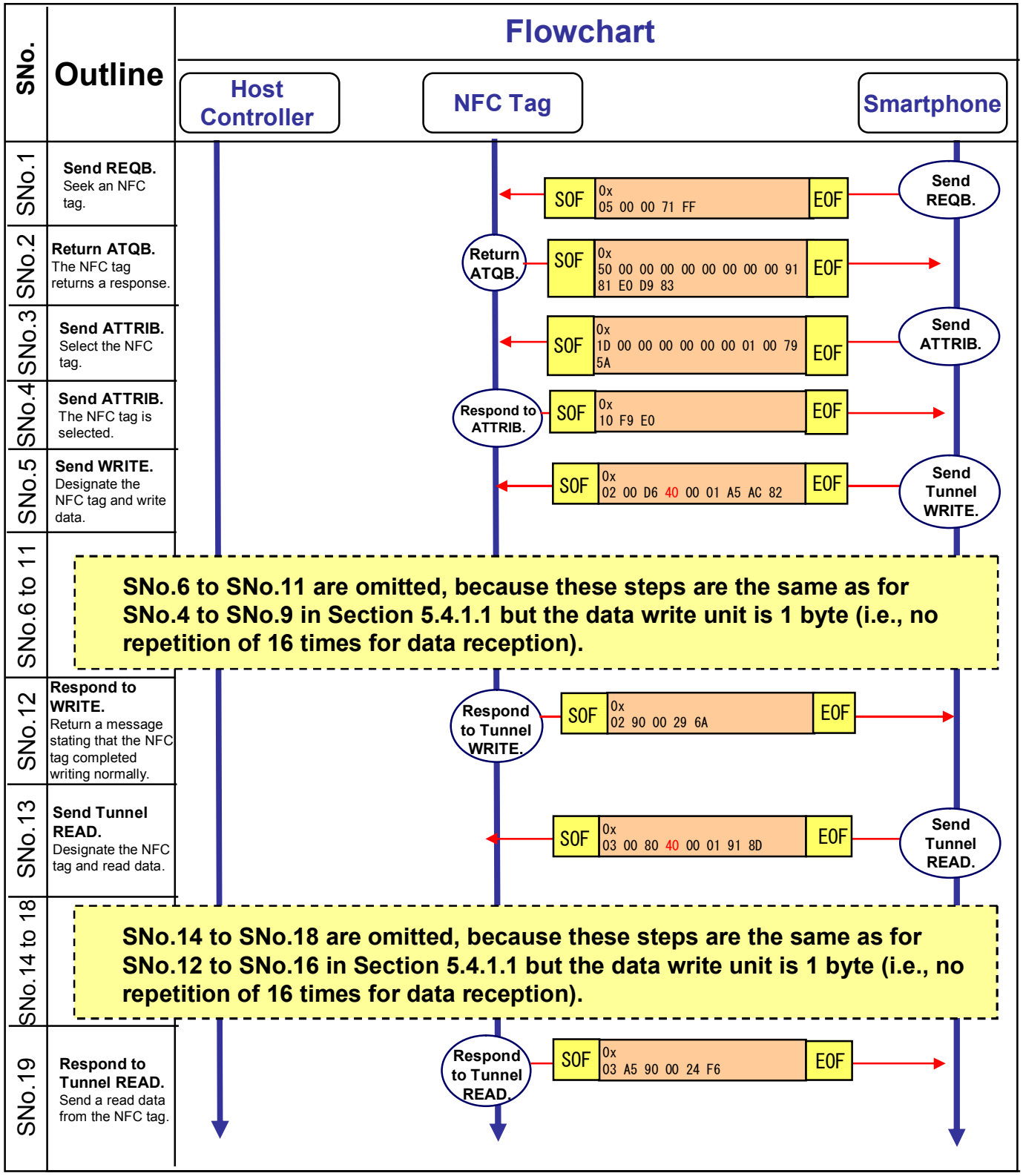
The outline of the operation flow is shown in the figure below.



SNo.1 to SNo.4: Same as SNo.1 to SNo.4 described in Section 5.3.3
SNo.5 to SNo.19: Same as SNo.3 to SNo.17 described in Section 5.4.1

5.4.2.1 Operation Flow Details

The operation flow is shown in the figure below.



5.4.2.2 Transmission/Reception Data Details (1/3)

REQB

SOF	CMD	AFI	PARAM	CRC		EOF
	05	00	00	71	FF	

Name	Description	Pattern	Comment
CMD	Command	0x05	REQB/WUPB command
AFI	Application Family Identifier	0x00	Overall response. See the ISO/IEC14443 standard.
PARAM	Parameter	0x00	Select REQB.
CRC	CRC calculated value	0x71FF	CRC calculated value

ATQB (Response to REQB)

SOF	RES CODE	PUPI				ApplicationData				Protocol Info			CRC		EOF
	50	00	00	00	00	00	00	00	00	91	81	E0	D9	83	

Name	Description	Pattern	Comment
RES CODE	Response code	0x50	ATQB (response to REQB)
PUPI	PICC identifier	0x00000000	Lower 4 bytes of IDM
Application Data	Application Data	0x00000000	Not used
Protocol Info	Protocol Info	0x9181E0	Parameter. See the User's Manual.
CRC	CRC calculated value	0xD983	CRC calculated value

ATTRIB

SOF	CMD	Identifier				PARAM				CRC		EOF
						1	2	3	4			
	1D	00	00	00	00	00	00	01	00	79	5A	

Name	Description	Pattern	Comment
CMD	Command code	0x1D	ATTRIB command
Identifier	PICC identifier	0x00000000	Specifies the PUPI of ATQB.
PARAM1	Parameter 1	0x00	See the User's Manual.
PARAM2	Parameter 2	0x00	See the User's Manual.
PARAM3	Parameter 3	0x01	See the User's Manual.
PARAM4	Parameter 4	0x00	See the User's Manual.
CRC	CRC calculated value	0x795A	CRC calculated value

5.4.2.2 Transmission/Reception Data Details (2/3)

Response to ATTRIB

SOF	RES CODE	CRC		EOF
	10	F9	E0	

Name	Description	Pattern	Comment
RES CODE	Response code	0x10	Response to ATTRIB
CRC	CRC calculated value	0xF9E0	CRC calculated value

Tunnel WRITE

SOF	PCB	CLA	INS	Address		LEN	DATA	CRC		EOF
	02	00	D6	40	00	01	A5	AC	82	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x02	I-block
CLA	CLA	0x00	Class byte; fixed value
INS	WRITE	0xD6	Instruction byte; WRITE = 0xD6
Address	Start address	**0x4000**	Address at which to start writes; **changed in tunnel mode**
LEN	Data length	0x01	Write data length (byte)
Data	Write data	0xA5	Write data
CRC	CRC calculated value	0xAC82	CRC calculated value

Response to Tunnel WRITE (Same Format as for Response to Normal WRITE)

SOF	PCB	SW		CRC		EOF
		1	2			
	02	90	00	29	6A	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x02	I-block
SW1	Status word 1	0x90	0x9000: No error
SW2	Status word 2	0x00	
CRC	CRC calculated value	0x296A	CRC calculated value

5.4.2.2 Transmission/Reception Data Details (3/3)

Tunnel READ

SOF	PCB	CLA	INS	Address		LEN	CRC		EOF
	03	00	B0	40	00	01	91	8D	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x03	I-block
CLA	CLA	0x00	Class byte; fixed value
INS	READ	0xB0	Instruction byte; READ = 0xB0
Address	Start address	**0x4000**	Address at which to start reads; **changed in tunnel mode**
LEN	Data length	0x01	Read data length (byte)
CRC	CRC calculated value	0x918D	CRC calculated value

Response to Tunnel READ (Same Format as for Response to Normal READ)

SOF	PCB	DATA	SW		CRC		EOF
			1	2			
	03	A5	90	00	24	F6	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x03	I-block
Data	Read data	0xA5	Read data
SW1	Status word 1	0x90	0x9000: No error
SW2	Status word 2	0x00	
CRC	CRC calculated value	0x24F6	CRC calculated value

5.5 Specifying System Area

Before using the NFC tag, the system area of the NFC tag LSI must be specified.

Before setting, the system area is not validated and set to the initial values fixed in hardware.

In the initial state fixed in hardware of the NFC tag LSI, 3 communication modes are available: RF communication (TYPE-B, FeliCa) and serial communication.

This section provides how to specify the system area using the three communication modes of RF communication (TYPE-B, FeliCa) and serial communication.

Examples of setting for writes is based on the initial state fixed in hardware. See the table below.

For more information about parameters, see the User's Manual.

Detail of Communication

Serial, TYPE-B, and FeliCa

Write the following setting parameters
to the blocks of 29 to31(the addresses of 0x01D0 to 0x01FF) in the NFC tag.

Parameters for Setting Examples

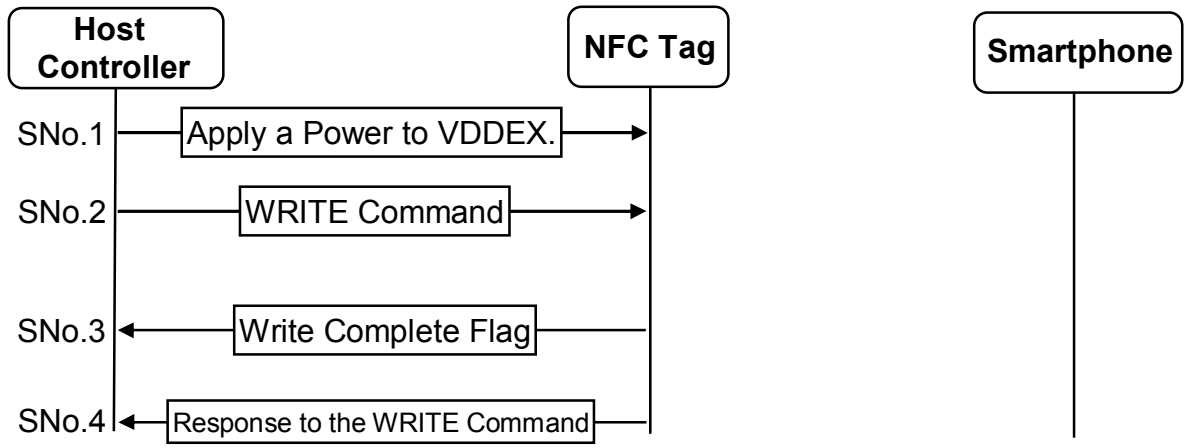
Block	Address		x0	x1	x2	x3	x4	x5	x6	x7	x8	x9	xA	xB	xC	xD	xE	xF
29	0x01DX	Parameter name	CONFIG															
		Value	00	00	00	00	00	00	00	00	01	23	45	67	89	AB	CD	EF
30	0x01EX	Parameter name	SC		IDM								PMM		AFI	FWI	HW	
		Value	AA	FF	02	FE	00	00	00	00	00	00	FF	FF	00	E0	00	54
31	0x01FX	Parameter name	RORF				ROSI				SECURITY				TN PRM	HW2	CONFIG2	
		Value	00	00	00	00	00	00	00	00	00	00	00	00	47	F0	00	2E

Outline of Parameters

Item	Name	Data size	Description
Setting value	CONFIG	16 bytes	For more information, see the User's Manual.
FeliCa communication parameter	SC	2 bytes	System code of JISX6319-4
	IDM	8 bytes	PICC identifier of JISX6319-4
	PMM	2 bytes	Response time of JISX6319-4
TYPE-B communication parameter	AFI	1 byte	Based on the AFI setting of ISO/IEC14443TYPE-B
	FWI	1 byte	Based on the AFI setting of ISO/IEC14443TYPE-B
Access restriction	RORF	4 bytes	Restricts writes in RF communication.
	ROSI	4 bytes	Restricts writes in serial communication.
	SECURITY	4 bytes	Specifies the plaintext access in RF communication.
Response setting	TNPRM	1 byte	Specifies the tunnel mode wait time.
	HW	2 bytes	Selects the RF communication specification for response. IDM setting, I2C slave address setting
	HW2	1 byte	Specifies the NIRQ generation source.
Setting value	CONFIG2	2 bytes	For more information, see the User's Manual.

5.5.1 Setting from Host Controller (Serial)

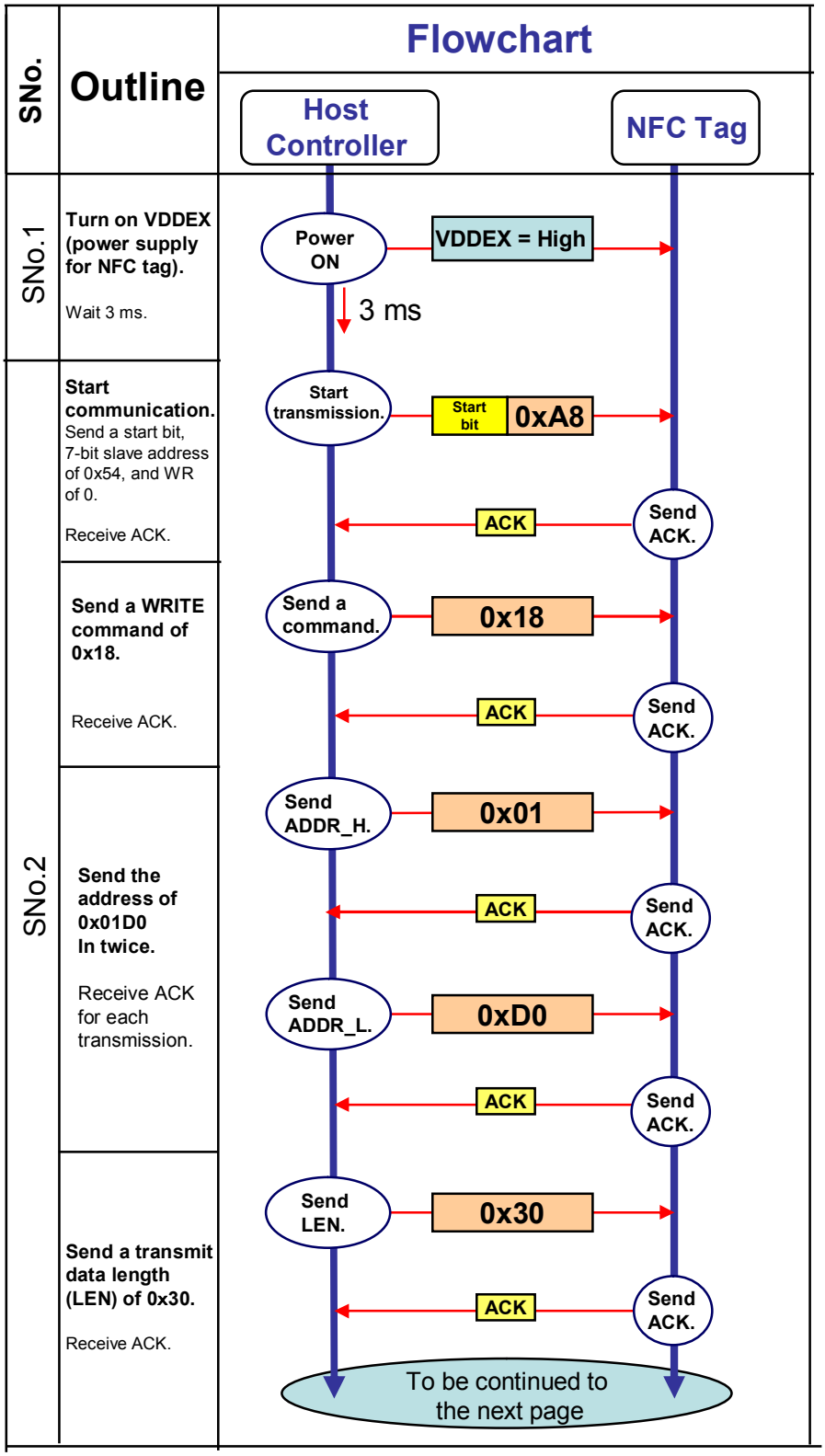
The outline of the operation flow is shown in the figure below.



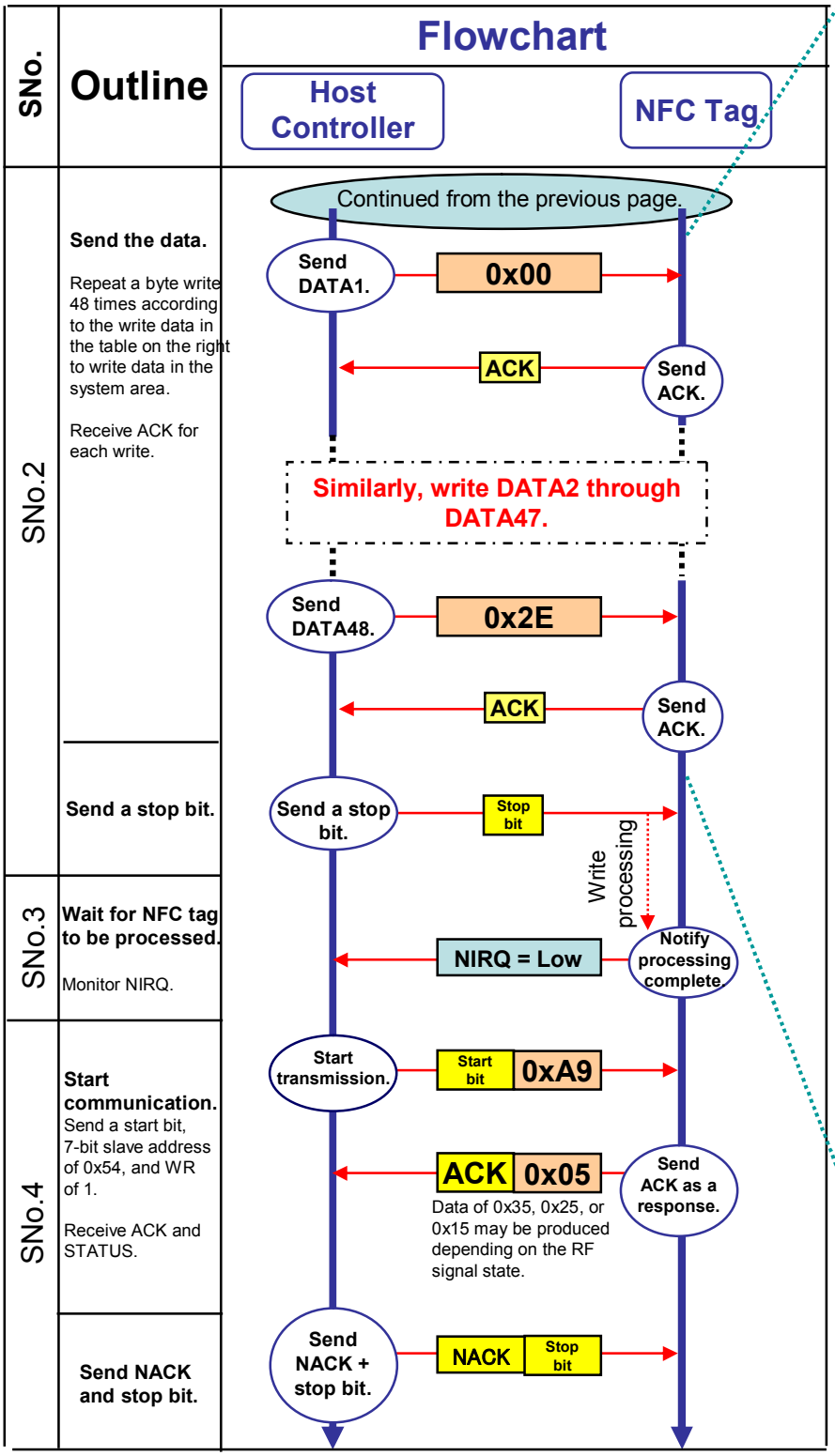
SNo.1: Apply a power to VDDEX pin and then wait 3 ms for a command to be received.
(See parameter E1 of the Product Standards.)
SNo.2: The host controller sends a WRITE command to the NFC tag. After receiving the command, the NFC tag processes the command.
SNo.3: After completing the command processing, the NFC tag returns an NIRQ as a write complete flag.
SNo.4: The NFC tag sends the processing results to the host controller as a response to the write command.

5.5.1.1 Operation Flow Details (1/2)

The detailed operation flow is shown in the figure below.



5.5.1.1 Operation Flow Details (2/2)



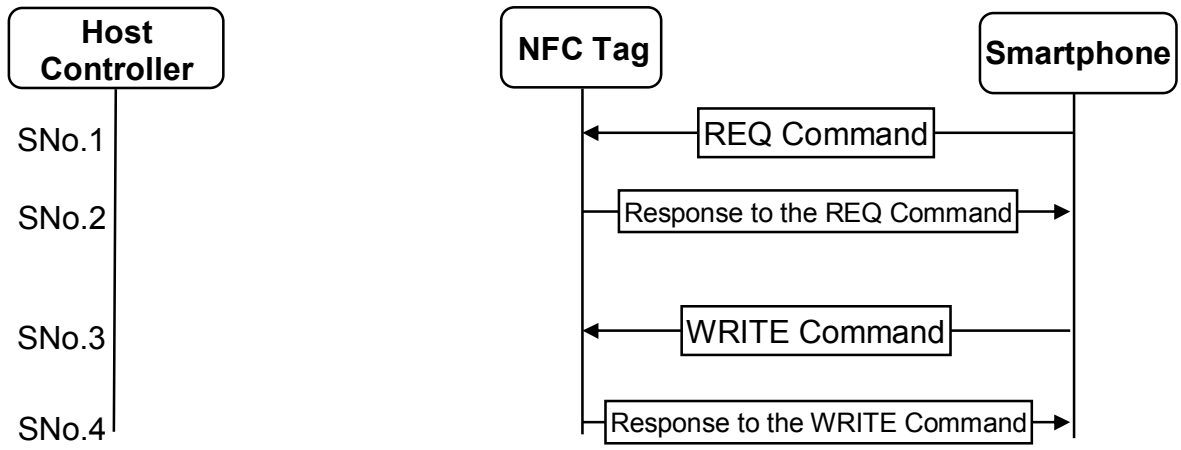
Write Data

DATA 1	0x 00
DATA 2	0x 00
DATA 3	0x 00
DATA 4	0x 00
DATA 5	0x 00
DATA 6	0x 00
DATA 7	0x 00
DATA 8	0x 00
DATA 9	0x 01
DATA 10	0x 23
DATA 11	0x 45
DATA 12	0x 67
DATA 13	0x 89
DATA 14	0x AB
DATA 15	0x CD
DATA 16	0x EF
DATA 17	0x AA
DATA 18	0x FF
DATA 19	0x 02
DATA 20	0x FE
DATA 21	0x 00
DATA 22	0x 00
DATA 23	0x 00
DATA 24	0x 00
DATA 25	0x 00
DATA 26	0x 00
DATA 27	0x FF
DATA 28	0x FF
DATA 29	0x 00
DATA 30	0x E0
DATA 31	0x 00
DATA 32	0x 54
DATA 33	0x 00
DATA 34	0x 00
DATA 35	0x 00
DATA 36	0x 00
DATA 37	0x 00
DATA 38	0x 00
DATA 39	0x 00
DATA 40	0x 00
DATA 41	0x 00
DATA 42	0x 00
DATA 43	0x 00
DATA 44	0x 00
DATA 45	0x 47
DATA 46	0x F0
DATA 47	0x 00
DATA 48	0x 2E

5.5.2 Setting from Smartphone (FeliCa)

This section describes how to specify the system area of the NFC tag from Smartphone (FeliCa).

The outline of the operation flow is shown in the figure below.

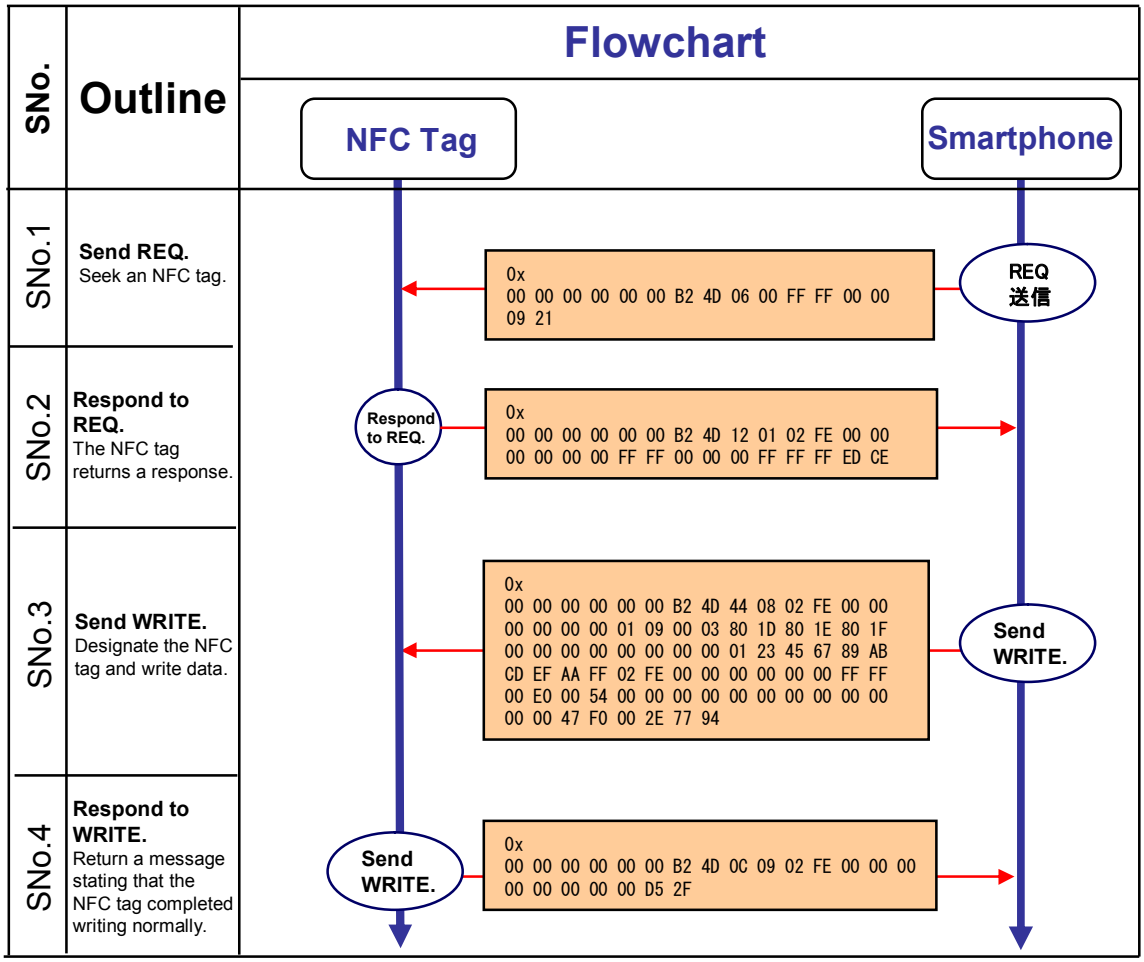


SNo.1: Smartphone sends a REQ command and waits for a response.
If NFC tag does not exist, the response to be returned in SNo.2 is not returned and SNo.1 is repeated.
SNo.2: The NFC tag returns a response to the REQ command sent in SNo.1.
The smartphone recognizes the NFC tag.
SNo.3: The smartphone sends a WRITE command.
The NFC tag receives the WRITE command and processes it.
SNo.4: The NFC tag sends the processing results to the smartphone.

Note: In Android terminal, the OS supports the processing of SNo. 1 and SNo. 2.

5.5.2.1 Operation Flow Details

The detailed operation flow is shown in the figure below.



5.5.2.2 Transmission/Reception Data Details (1/3)

This section describes the transmit and receive data shown in the operation flow. For more information, see the User's Manual.

REQ

Start Field								Information Field						End Field	
PREAMBLE						SYNC CODE		LEN	CMD	SYS CODE		REQ CODE	SLOT	CRC	
00	00	00	00	00	00	B2	4D	06	00	FF	FF	00	00	09	21

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x06	Byte length of information field
CMD	Command	0x00	Code of REQ command
SYS CODE	System code	0xFFFF	Responds independent of the system area SC.
REQ CODE	Request code	0x00	Processed as "No request"
SLOT	Timeslot	0x00	Always set to 00 in this LSI.
CRC	CRC calculated value	0x0921	CRC calculated value of information field

Response to REQ

Start Field								Information Field																End Field	
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE								DATA FIELD								CRC	
00	00	00	00	00	00	B2	4D	12	01	02	FE	00	00	00	00	00	00	FF	FF	00	00	00	FF	FF	FF	ED	CE

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x12	Byte length of information field
CMD	Command	0x01	Response code to REQ
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
PMM	Response time descriptor	0xFFFF000000FFFFFF	Time until NFC tag returns a response
CRC	CRC calculated value	0xEDCE	CRC calculated value of information field

5.5.2.2 Transmission/Reception Data Details (2/3)

WRITE

Start Field								Information Field																									
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE								SVS NUM	SVS		Blk NUM	Block List												
																						1			2				3				
00	00	00	00	00	00	B2	4D	44	08	02	FE	00	00	00	00	00	00	01	09	00	01	80	1D	80	1E	80	1F						

~

~

DATA																																	
CONFIG																SC		IDM															
00	00	00	00	00	00	00	00	01	23	45	67	89	AB	CD	EF	AA	FF	02	FE	00	00	00	00	00	00								

~

~

DATA																																End Field	
PMM		AFI	FWI	HW		RORF				ROSI				SECURITY				TNPRM	HW2	CONFIG 2												CRC	
FF	FF	00	E0	00	54	00	00	00	00	00	00	00	00	00	00	00	00	47	F0	00	2E											77	94

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x44	Byte length of information field
CMD	Command	0x08	Code of WRITE command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
SVSNUM	Number of service files	0x03	Number of service files
SVS	Service file identifier	0x0900	Service file identifier
BLK NUM	Number of blocks	0x01	Number of write blocks
BLK List	Block list	0x801D、0x801E、0x801F	Specifies write block.
DATA	Write data	0x 00 00 00 00 00 00 00 00 01 23 45 67 89 AB CD EF AA FF 02 FE 00 00 00 00 00 00 FF FF 00 E0 00 54 00 00 00 00 00 00 00 00 00 00 00 00 47 F0 00 2E	Write data
CRC	CRC calculated value	0x7794	CRC calculated value of information field

5.5.2.2 Transmission/Reception Data Details (3/3)

Response to WRITE

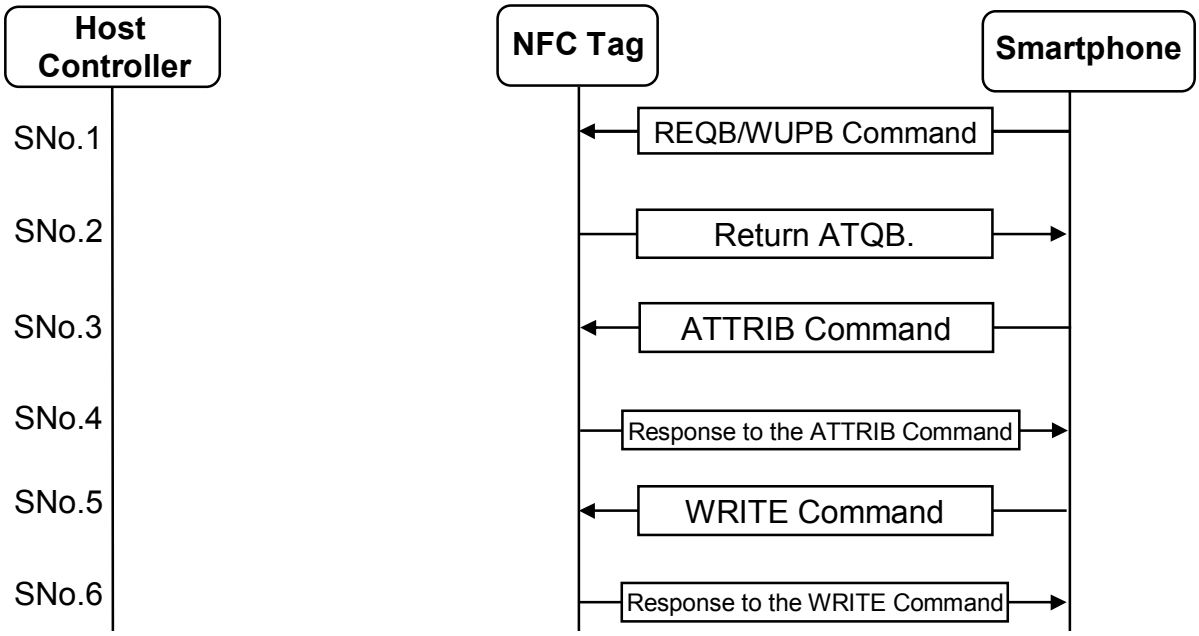
Start Field								Information Field												End Field	
PREAMBLE						SYNC CODE		LEN	CMD	PICC CODE								STATUS 1	STATUS 2	CRC	
00	00	00	00	00	00	B2	4D	0C	09	02	FE	00	00	00	00	00	00	00	00	D5	2F

Name	Description	Pattern	Comment
PREAMBLE	Preamble	0x000000000000	Fixed value given when starting communication
SYNC CODE	Synchronous code	0xB24D	Fixed value given when starting communication
LEN	Information field length	0x0C	Byte length of information field
CMD	Command	0x09	Response code to WRITE command
PICC CODE	PICC identifier	0x02FE000000000000	IDM default value of NFC tag
STATUS1	Status flag 1	0x00	00: Normal termination
STATUS2	Status flag 2	0x00	00: Normal termination
CRC	CRC calculated value	0xD52F	CRC calculated value of information field

5.5.3 Setting from Smartphone (TYPE-B)

This section describes how to specify the system area of the NFC tag from smartphone (TYPE-B).

The outline of the operation flow is shown in the figure below.

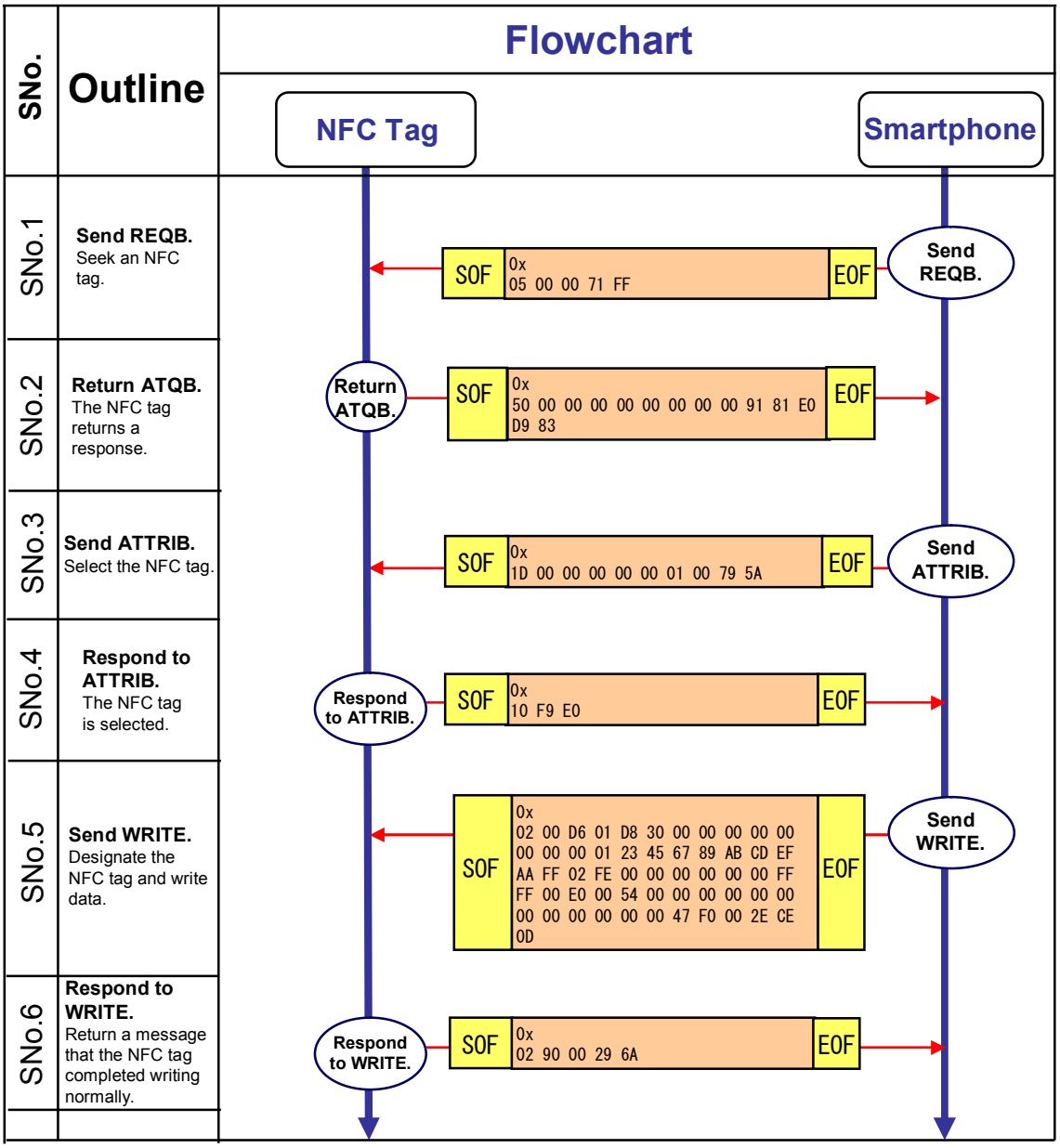


SNo.1: Smartphone sends a REQB command and waits for a response.
If NFC tag does not exist, the response to be returned in SNo.2 is not returned and SNo.1 is repeated.
SNo.2: The NFC tag returns an ATQB as a response to the REQB command sent in SNo.1.
The smartphone recognizes the NFC tag.
SNo.3: The smartphone sends an ATTRIB command.
SNo.4: The NFC tag returns a response to the ATTRIB command sent in SNo.3.
The NFC tag is activated.
SNo.5: The smartphone sends a WRITE command.
The NFC tag receives the WRITE command and processes it.
SNo.6: The NFC tag sends the processing results to the smartphone.

Note: In Android terminal, the OS supports the processing of SNo. 1 to SNo. 4.

5.5.3.3 Operation Flow Details

The detailed operation flow is shown in the figure below.
For waveform specification and SOF/EOF patterns, see the ISO/IEC14443 standard.
Data is sent in units of 10 bits, to which values of 0 and 1 have been given as the first and last bits, respectively, in units of 8 bytes.
These specifications are also specified in the ISO/IEC 14443 standard.



5.5.3.2 Transmission/Reception Data Details (1/2)

REQB

SOF	CMD	AFI	PARAM	CRC		EOF
	05	00	00	71	FF	

Name	Description	Pattern	Comment
CMD	Command	0x05	REQB/WUPB command
AFI	Application Family Identifier	0x00	Overall response. See the ISO/IEC14443 standard.
PARAM	Parameter	0x00	Selects REQB.
CRC	CRC calculated value	0x71FF	CRC calculated value

ATQB (Response to REQB)

SOF	RES CODE	PUPI				ApplicationData				Protocol Info			CRC		EOF
	50	00	00	00	00	00	00	00	00	91	81	E0	D9	83	

Name	Description	Pattern	Comment
RES CODE	Response code	0x50	ATQB (response to REQB)
PUPI	PICC identifier	0x00000000	Lower 4 bytes of IDM
Application Data	Application Data	0x00000000	Not used
Protocol Info	Protocol Info	0x9181E0	Parameter. See the User's Manual.
CRC	CRC calculated value	0xD983	CRC calculated value

ATTRIB

SOF	CMD	Identifier				PARAM				CRC		EOF
						1	2	3	4			
	1D	00	00	00	00	00	00	01	00	79	5A	

Name	Description	Pattern	Comment
CMD	Command code	0x1D	ATTRIB command
Identifier	PICC identifier	0x00000000	Specifies the PUPI of ATQB.
PARAM1	Parameter 1	0x00	See the User's Manual.
PARAM2	Parameter 2	0x00	See the User's Manual.
PARAM3	Parameter 3	0x01	See the User's Manual.
PARAM4	Parameter 4	0x00	See the User's Manual.
CRC	CRC calculated value	0x795A	CRC calculated value

5.5.3.2 Transmission/Reception Data Details (2/2)

Response to ATTRIB

SOF	RES CODE	CRC		EOF
	10	F9	E0	

Name	Description	Pattern	Comment
RES CODE	Response code	0x10	Response to ATTRIB
CRC	CRC calculated value	0xF9E0	CRC calculated value

WRITE

SOF	PCB	CLA	INS	Address		LEN
	02	00	D6	01	D0	30

~

DATA																											
CONFIG																SC		IDM									
00	00	00	00	00	00	00	00	01	23	45	67	89	AB	CD	EF	AA	FF	02	FE	00	00	00	00	00	00	00	00

~

DATA																								CRC		EOF
PMM		AFI	FWI	HW		RORF				ROSI				SECURITY				TNP RM	HW2	CONFIG2						
FF	FF	00	E0	00	54	00	00	00	00	00	00	00	00	00	00	00	00	47	F0	00	2E	CE	0D			

~

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x02	I-block
CLA	CLA	0x00	Class byte; fixed value
INS	WRITE	0xD6	Instruction byte; WRITE = 0xD6
Address	Start address	0x01D0	Address at which to start writes
LEN	Data length	0x30	Write data length (byte)
Data	Write data	0x 00 00 00 00 00 00 00 00 01 23 45 67 89 AB CD EF AA FF 02 FE 00 00 00 00 00 00 FF FF 00 E0 00 54 00 00 00 00 00 00 00 00 00 00 00 00 47 F0 00 2E	Write data
CRC	CRC calculated value	0xCE 0D	CRC calculated value

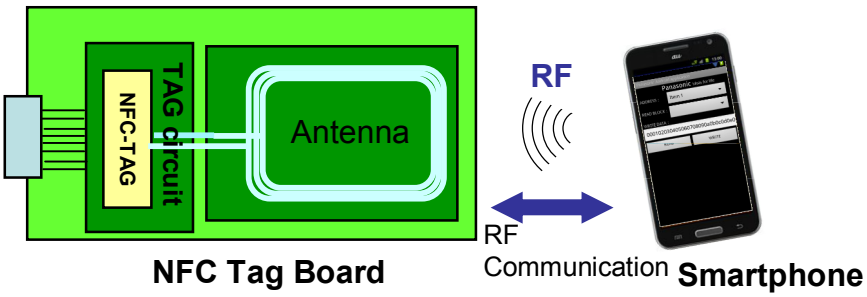
Response to WRITE

SOF	PCB	SW		CRC		EOF
		1	2			
	02	90	00	29	6A	

Name	Description	Pattern	Comment
PCB	Protocol Control Byte	0x02	I-block
SW1	Status word 1	0x90	0x9000: No error
SW2	Status word 2	0x00	
CRC	CRC calculated value	0x296A	CRC calculated value

Appendix

Appendix 1 RF Communication Demonstration



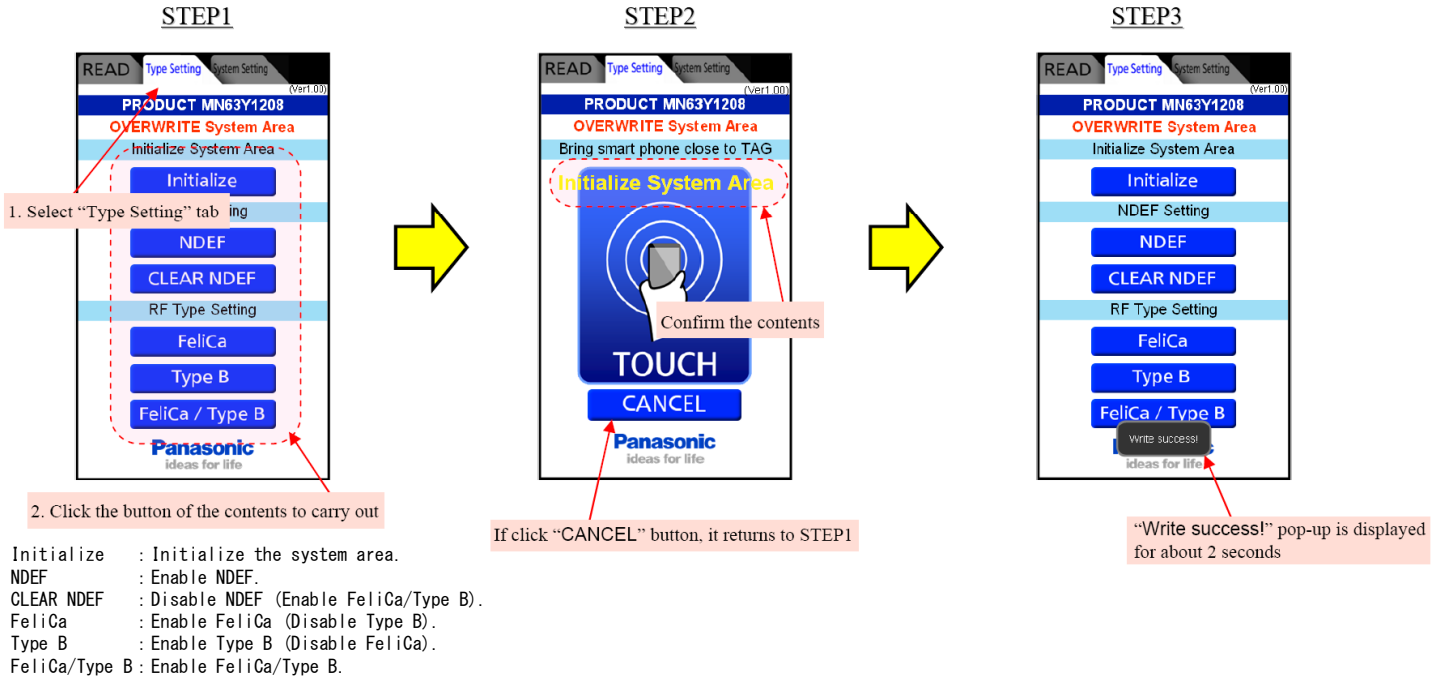
This demo shows an RF communication between NFC tag and smartphone.
Below is an outline of the demo with sample application software.

How to Use the Application Software for Tag Type Setting (System Area Setting)

Software name for Smartphone : 1208Tag Setting
apk : Panasonic_TagSetting1208_v100.apk

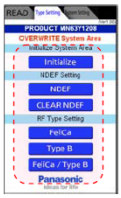
(1) Set the NFC tag to a desired communication format.

- **STEP1** : Select "Type Setting" tab and click the button of the contents to carry out
- **STEP2** : Since a TOUCH screen opens, bring a smart phone close to TAG
- **STEP3** : "Type Setting" screen opens automatically. "Write success!" pop-up is displayed for about 2 seconds



Initialize : Initialize the system area.
NDEF : Enable NDEF.
CLEAR NDEF : Disable NDEF (Enable FeliCa/Type B).
FeliCa : Enable FeliCa (Disable Type B).
Type B : Enable Type B (Disable FeliCa).
FeliCa/Type B : Enable FeliCa/Type B.

The data which written by each button click of Type Setting



- **Initialize**

Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x01b0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x01c0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x01d0	00	00	00	00	00	00	00	00	01	23	45	67	89	ab	cd	ef
0x01e0	aa	ff	02	fe	00	00	00	00	00	00	ff	ff	00	e0	00	54
0x01f0	00	00	00	00	00	00	00	00	00	00	00	00	47	f0	00	2e

- **NDEF**
  - Smart Poster
    Title : panasonic
    URI : http://panasonic.net

Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x0000	10	01	01	00	14	00	00	00	00	00	01	00	00	28	00	4f
0x0010	d1	02	23	53	70	91	01	0c	54	02	6a	61	70	61	6e	61
0x0020	73	6f	6e	69	63	51	01	0f	55	03	70	61	6e	61	73	6f
0x0030	6e	69	63	2e	6e	65	74	2f	00	00	00	00	00	00	00	00
0x0180	00	0f	20	00	3b	00	34	04	06	01	03	00	c8	00	00	00
0x01e0	12	fc	--	--	--	--	--	--	--	--	--	--	--	--	**	--
0x01f0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	++

(--:The read value is written in as it is,
**:FeliCa / Type B Mode,
++:Calculated value)

**

0x01ee	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Felica / Type B	-	-	0	0	-	-	-	-
FeliCa	-	-	0	1	-	-	-	-
Type B	-	-	1	0	-	-	-	-

(-:The read value is written in as it is)

++ Please refer to Administrator's Manual about the calculation method

- **CLEAR NDEF**

Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x0000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x0180	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x01e0	aa	ff	--	--	--	--	--	--	--	--	--	--	--	--	**	--
0x01f0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	++

(--:The read value is written in as it is,
**:FeliCa / Type B Mode,
++:Calculated value)

- **FeliCa**

Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x01e0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**	--
0x01f0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	++

(--:The read value is written in as it is,
**:FelCiCa Mode,
++:Calculated value)

- **Type B**

Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x01e0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**	--
0x01f0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	++

(--:The read value is written in as it is,
**:Type B Mode,
++:Calculated value)

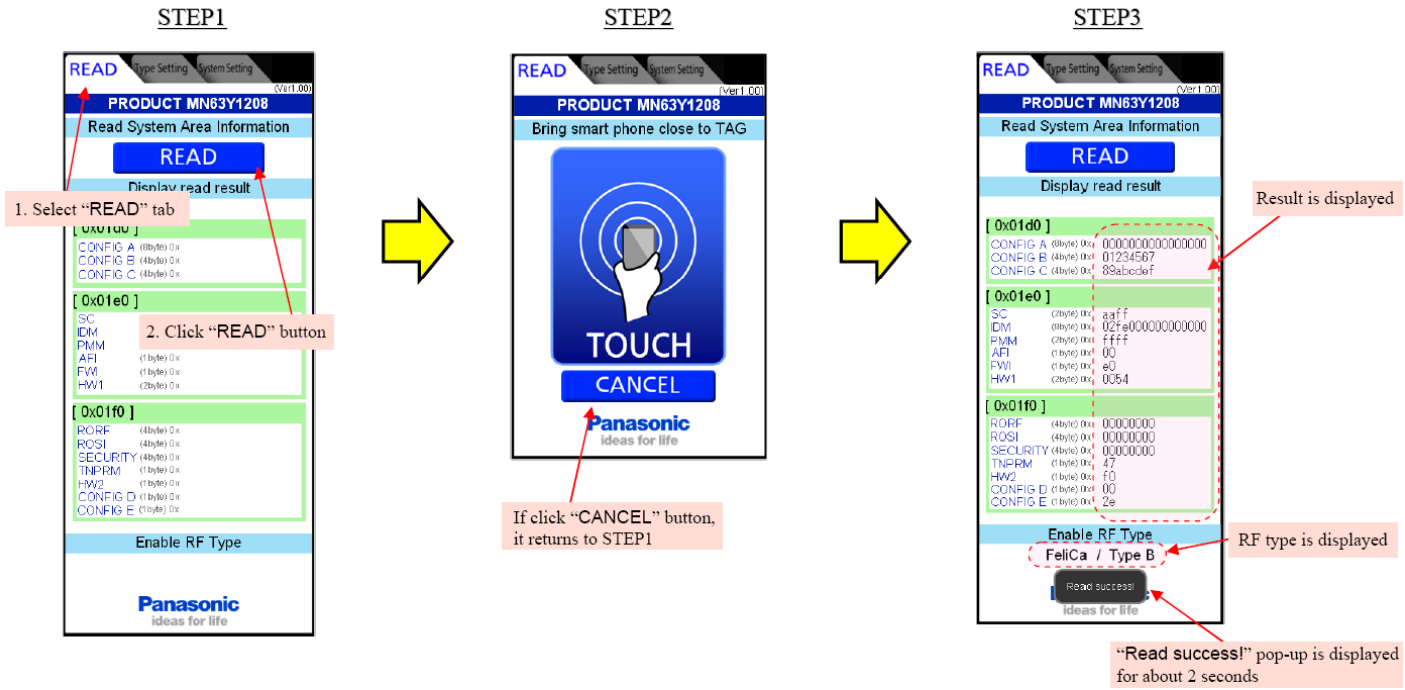
- **FeliCa / Type B**

Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
0x01e0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**	--
0x01f0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	++

(--:The read value is written in as it is,
**:FeliCa / Type B Mode,
++:Calculated value)

(2) Read System Area of the NFC tag.

- **STEP1** : Select the "READ" tab and click "READ" button
- **STEP2** : Since a TOUCH screen opens, bring a smart phone close to TAG
- **STEP3** : "READ" screen opens automatically and a result is displayed. "Read success!" pop-up is displayed for about 2 seconds



How to Use the Application Software for Tag Communication (User Area Read/Write)

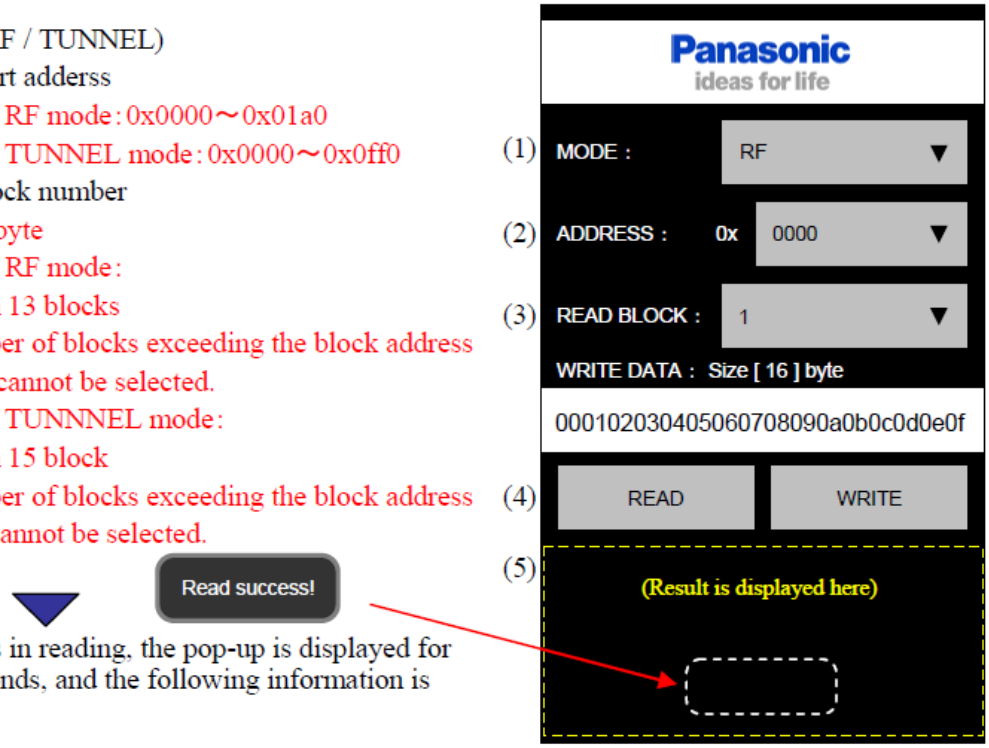
Software name for Smartphone : Tag ReaderWriter
apk : Panasonic_TagReaderWriterFBRT_v102.apk

Launch the TagReaderWriter_typeFB application software to read/write from/to the user area of the NFC tag through a communication with tag. The read process is as follows:

- **STEP1** : Start an application by one of the following methods.
  - Select application and start.
  - Bring Smart Phone close to NFC TAG and start.
- **STEP2** : Execute Read/Write in the following procedures.

[Read]

(1) Select mode (RF / TUNNEL)
(2) Select Read start adderss
※When select RF mode: 0x0000～0x01a0
※When select TUNNEL mode: 0x0000～0x0ff0
(3) Select Read block number
※1block = 16byte
※When select RF mode:
maximum 13 blocks
The number of blocks exceeding the block address 0x01a0 cannot be selected.
※When select TUNNNEL mode:
maximum 15 block
The number of blocks exceeding the block address 0x0ff0 cannot be selected.
(4) Excecute Read
(5) When succeeds in reading, the pop-up is displayed for about 2 seconds, and the following information is displayed.

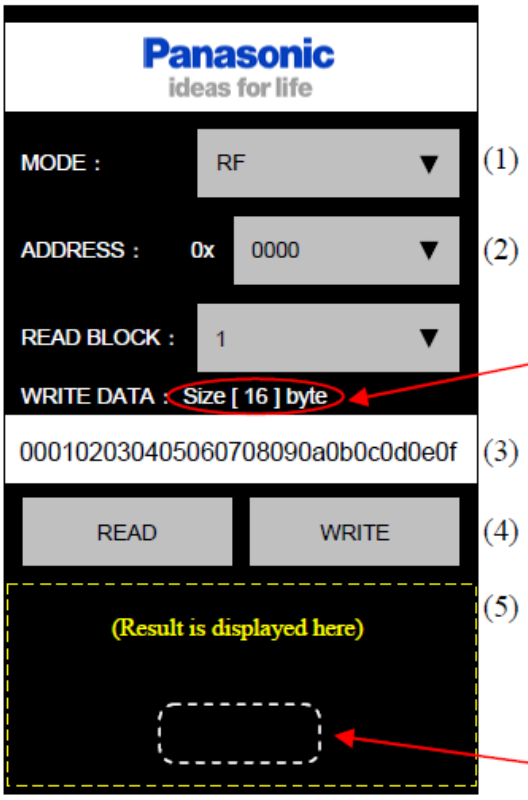


※Type F response

```
Connection : Type F    (TAG type)
[response data]
 Len : 1d   (Read total data length)
 Code : 07  (Response Code from TAG)
 PICC : 02 fe 00 00 00 00 00 00
 SF1 : 00   (Status Flag 1)
 SF2 : 00   (Status Flag 2)
 Block : 01  (Read block number)
 Data :      (Read data)
0x0000 : 00 01 02 03 04 05 06 07
         08 09 0a 0b 0c 0d 0e 0f
```

※Type B response

```
Connection : Type B  (TAG type)
[response data]
 Data :      (Read data)
0x0000 : 00 01 02 03 04 05 06 07
         08 09 0a 0b 0c 0d 0e 0f
SW : 90 00   (Status Word)
```



[Write]

(1) Select mode (RF / TUNNEL)

(2) Select Write start address

※When select RF mode : 0x0000～0x01a0

※When select TUNNEL mode : 0x0000～0x0ff0

(3) Setup Write data

※Setup is possible to 192byte

※Confirm input data size

※Input data per byte by a hexadecimal number(0～f)

※1byte consists of 2 hexadecimal number

※When response Type F, write data need to be consisted of block unit(16 byte). It rectifies, when insufficient.

(E.g.) input : aa ff -> Write aa ff 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

※When select RF mode :

Write command exceeding the block address 0x01af ignores.

※When select TUNNEL mode :

Write command exceeding the block address 0x0fff ignores.

(4) Execute Write

(5) When succeeds in writing, the pop-up is displayed for about 2 seconds, and the following information is displayed.

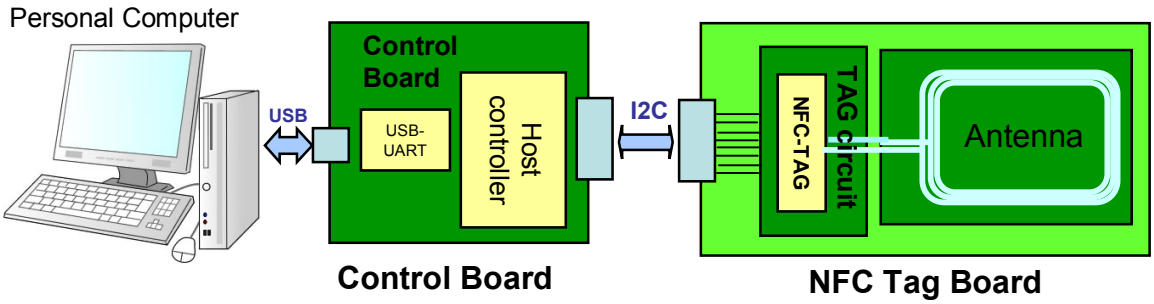
※Type F response

```
Connection : Type F   (TAG type)
[response data]
 Len : 0c  (Write total data length)
 Code : 09 (Response Code from TAG)
 PICC : 02 fe 00 00 00 00 00 00
 SF1 : 00  (Status Flag 1)
 SF2 : 00  (Status Flag 2)
```

※Type B response

```
Connection : Type B  (TAG type)
[response data]
SW : 90 00   (Status Word)
```

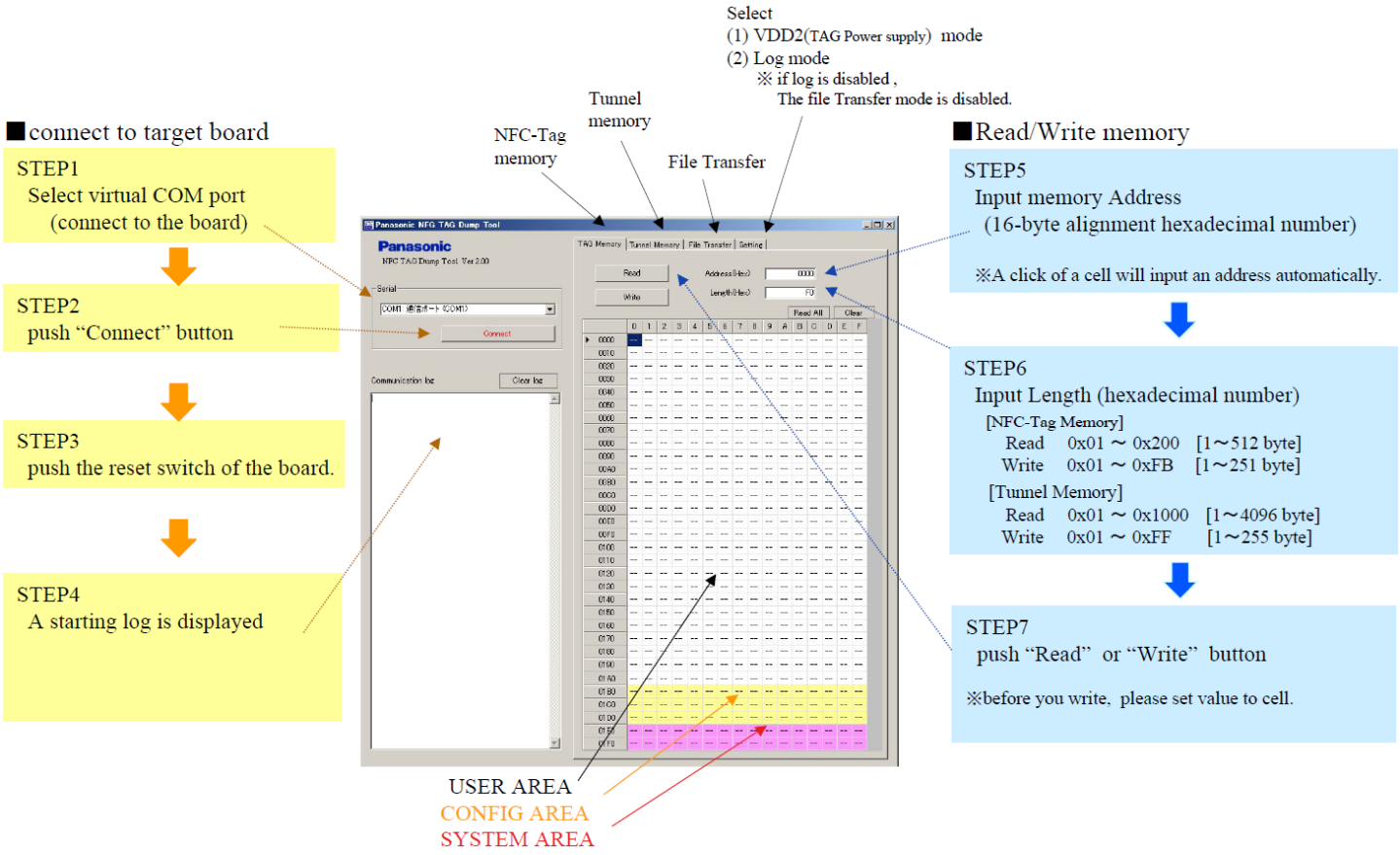
Appendix 2 Serial Communication Demonstration



Serial Communication Demonstration Scenario Environment

An outline of the serial communication demonstration environment is shown in the figure above. This demo shows the following: the GUI provided on the PC communicates with the host controller on the control board via USB, and the host controller communicates with the NFC tag board through I2C. As a result, it is possible to read/write from/to the NFC tag memory area, from the GUI on the PC. The demo runs as shown below.

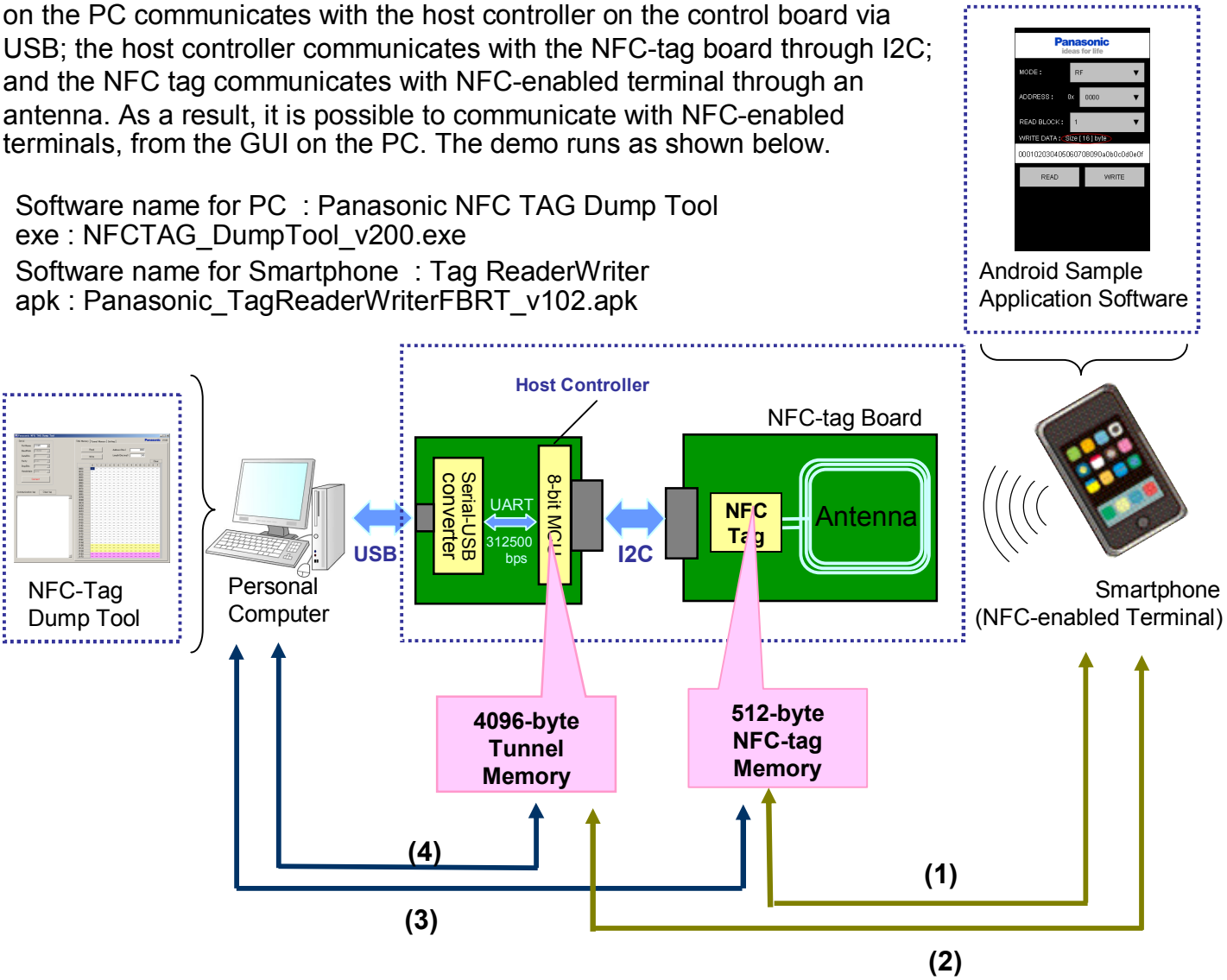
Software name for PC : Panasonic NFC TAG Dump Tool
exe : NFCTAG_DumpTool_v200.exe



Appendix 3 Tunnel Communication Demonstration

An outline of the tunnel communication demonstration environment is shown in the figure below. This demo shows the following: the GUI provided on the PC communicates with the host controller on the control board via USB; the host controller communicates with the NFC-tag board through I2C; and the NFC tag communicates with NFC-enabled terminal through an antenna. As a result, it is possible to communicate with NFC-enabled terminals, from the GUI on the PC. The demo runs as shown below.

Software name for PC : Panasonic NFC TAG Dump Tool
exe : NFCTAG_DumpTool_v200.exe
Software name for Smartphone : Tag ReaderWriter
apk : Panasonic_TagReaderWriterFBRT_v102.apk



Tunnel Communication Demonstration Scenario Environment

Operating Sequence

(1) Read/write from/to the NFC-tag memory via NFC from smartphone.
(2) Read/write from/to the tunnel memory via NFC from smartphone.
(3) Read/write from/to the NFC-tag memory from PC (or Host Controller).
(4) Read/write from/to the tunnel memory from PC.

* Tunnel memory = Memory inside the Host Controller

Appendix 4 Environment to Provide Application Software for Smartphone

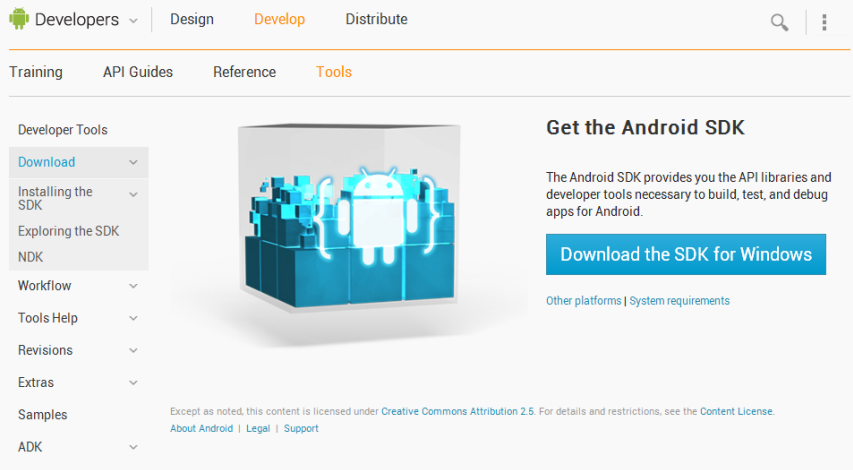
We can provide the separate “NFC-Tag Android Application Implementation Manual.”
Our development environment for operation verification and how to get software are as follows:

◆ Our Verification Environment

[Development Environment]
Intel® Core™2 Duto CPU@3.16GHz, 3.50GB RAM
Microsoft Windows XP Professional Version 2002 Service Pack 2
Eclipse Version:Indigo Service Release 2
SDK Platform Android 2.3.3(API 10)

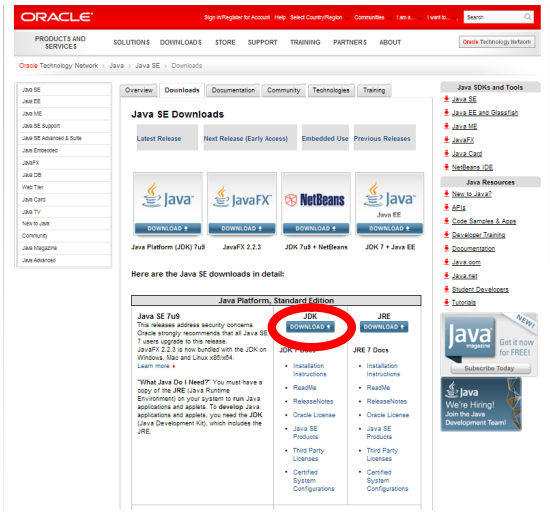
◆ Getting the Android SDK

Download the SDK corresponding to your OS from the site of
http://developer.android.com/sdk/index.html
Android SDK | Android Developers .



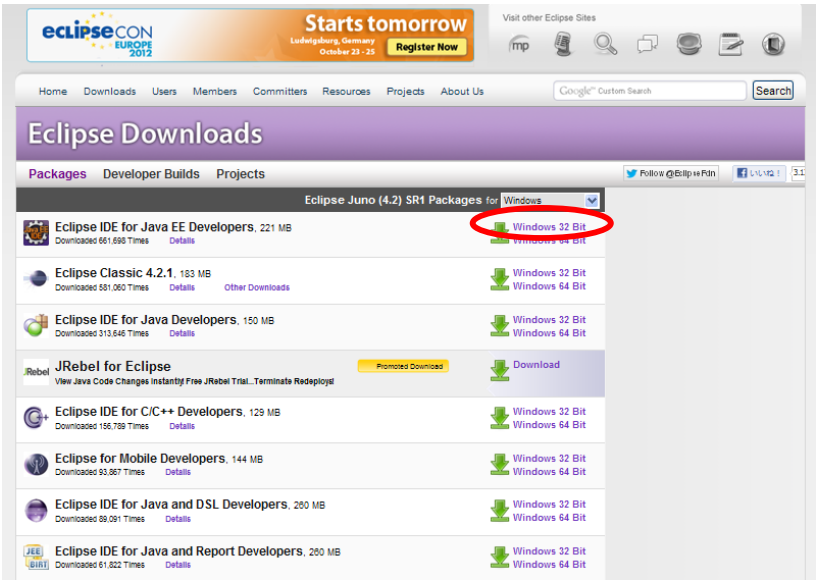
◆ Getting the JDK

Download the JDK from the site of
http://www.oracle.com/technetwork/java/javase/downloads/index.html
Java SE Downloads.
Click the “DOWNLOAD” button of JDK.



◆ Getting the Eclipse

Download the Eclipse from the site of http://www.eclipse.org/downloads/
Eclipse Downloads.



◆ Installing the Eclipse

Install the “Android Development Tools (ADT) plugin” to develope Android using Eclipse.

1. Launch the Eclipse, and click “Help > Install New Software.”
2. In the Install window, in the “Work with:” field, enter the following URL and click Add: http://dl-ssl.google.com/android/eclipse/.
3. In the Add Repository window, name the repository such as “Android Plugin” and input the repository URL http://dl-ssl.google.com/android/eclipse/.
4. Return to the Install window, and click the link “Available Software Site”; select “Android Plugin,” and click “Reload” button.
5. In the Install window, select all development tools to install, and click Next.
6. Follow the Install window instructions.

Appendix 5 BTPB-101B Design Data

This section summarizes the design data for the microcontroller board that is used in the host control example of this document.

The board is also used for a demonstration board provided by us.

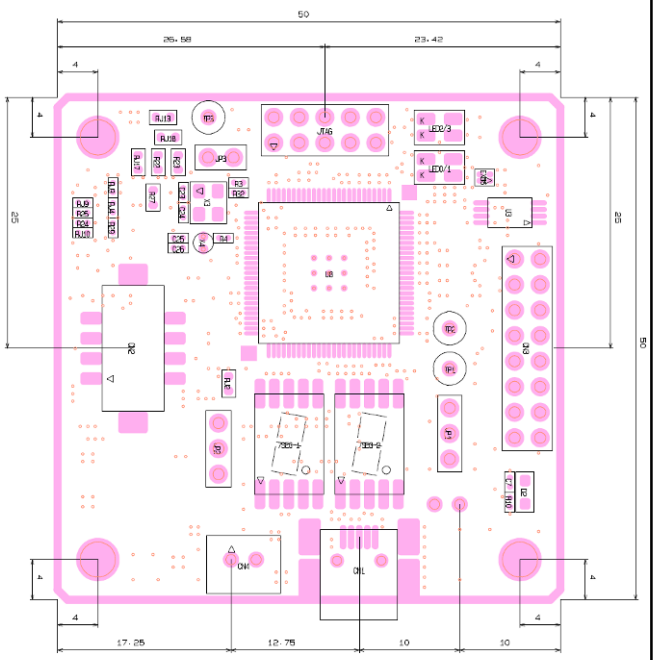
Photograph of BTPB-101B

Side A F

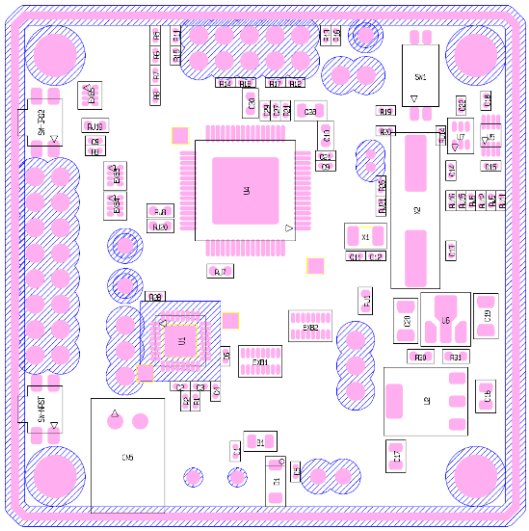
Side B ㄱ

Parts Layout of BTPB-101B

Side A F



Side B ㄱ



BTPB-101B Parts List

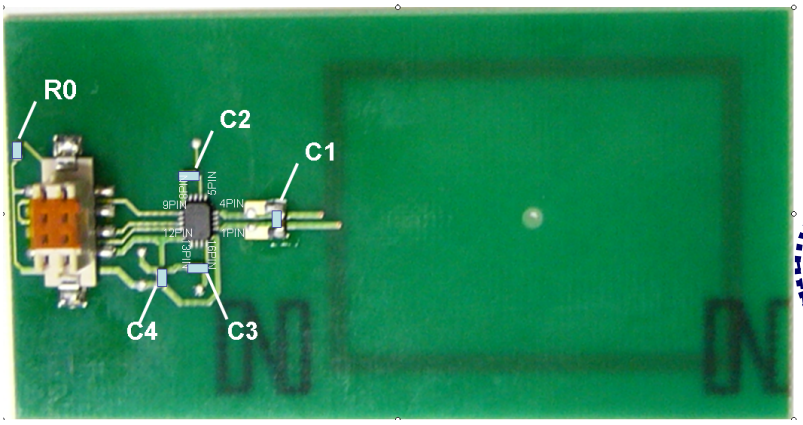
Name	Description	Count	Number												
23K256-I/ST	SPI-SRAM	1	U3												
67503-1020	USB connector	1	CN1												
ACSA02-41SGWA-F01	7-segment LED	2	7SEG-1	7SEG-2											
AP1115AY18G-13	1.8-V LDO	0	~~U6~~												
B2B-XH-A	Power supply connector	1	CN4												
BLM21PG331SN1	Ferrite	1	B1												
BRPY1201W	LED	2	LED0/1	LED2/3											
C3216X5R1E476M	47μ	0	~~C19~~	~~C20~~											
CNZ1E4KTTD	4 jumpers in series	2	EXB3	~~EXB4~~	EXB5										
CX3225GB10000D0HEQZ1	10M	0	~~X3~~												
DF11CZ-8DP-2V(27)	CN2 connector	1	CN2												
EVQPUJ02K	Switch	2	SW-IRQ2	SW-NRST											
EXB-24VR000X	2 jumpers in series	0	~~EXB6~~												
EXB-2HV102JV	Eight 1-kΩ resistors in series	2	EXB1	EXB2											
FFC-10BMEP1B	Connector for D-WIRE	1	JTAG												
FFC-16BMEP1B	Connector for CN3	1	CN3												
FT232RQ-REEL	USB-serial conversion IC	1	U1												
GRM1555C1H100JZ01D	10 pF capacitor	0	~~C23~~	~~C24~~											
GRM1555C1H200JZ01D	20 pF capacitor	4	C11	C12	C13	C14									
GRM1555C1H470JZ01D	47 pF capacitor	2	C2	C3											
GRM1555C1H9R0DA01D	9 pF capacitor	0	~~C25~~	~~C26~~											
GRM188B31E105KA75DD	1 μF capacitor	1	C10	~~C30~~											
GRM21BF51E475ZA01L 2125/25V	4.7 μF capacitor	0	~~C28~~												
GRM21BR61E106KA73L 2125/25V/10%	10 μF capacitor	2	C16	C17											
KHS22	Switch	1	SW1												
LC-2-B-BLACK	Tap pin	1	TP2												
LC-2-R-RED	Tap pin	1	TP1												
LC-2-Y-YELLOW	Tap pin	1	TP3												
LT1117CST-3.3	3.3-V LDO	1	U2												
MMSZ5V6T1G	Diode	1	D1												
MN101EG63G	Microcontroller	1	U4												
U8	Microcontroller (option)	0	~~U8~~												
NKD SD3 10.000MHz 16pF	10 MHz oscillator	1	X2												
RB501V-40TE-17	1S1588	1	D2												
RK73B1ETTP103J	10 kΩ resistor	9	R9	R10	R15	R16	R17	R18	R19	R20	R21	~~R28~~			
RK73B1ETTP105J	1 MΩ resistor	1	R26	~~R32~~											
RK73B1ETTP271J	270 Ω resistor	0	~~R3~~												
RK73B1ETTP330J	33 Ω resistor	4	R11	R12	R13	R14									
RK73B1ETTP331J	330 Ω resistor	4	R5	R6	R7	R8									
RK73B1ETTP332J	3.3 kΩ resistor	0	~~R24~~	~~R25~~	~~R29~~										
RK73B1ETTP363J	36 kΩ resistor	0	~~R4~~												
RK73B1JTTD332J	3.3 kΩ resistor	3	R22	R23	R27										
RK73B1JTTD601J	600 Ω resistor	0	~~R30~~												
RK73Z1ETTP	Jumper	10	R1	R2	~~RJ3~~	RJ4	~~RJ5~~	~~RJ6~~	RJ9	RJ10	RJ11	RJ12	RJ14	~~RJ15~~	RJ16	RJ21
RK73Z1JTTD	Jumper	5	~~R31~~	~~RJ1~~	RJ2	RJ7	~~RJ8~~	RJ13	RJ17	~~RJ18~~	RJ19	~~RJ20~~				
S2B-XH-A	Power supply connector	1	CN5												
ST3215SB32768H5HPWAA ±20ppm 12.5pF	32.768 kHz oscillator	1	X1												
TC7PG34FU	Buffer (option)	0	~~U7~~												
TMK105BJ104KV-F	0.1 μF capacitor	8	C1	C4	C5	C6	C7	C8	C9	~~C15~~	~~C18~~	C21	~~C22~~	~~C27~~	~~C29~~
TXS0102DCUR	Bidirectional level shifter	0	~~U5~~												
VT-200-F12.5-32.768KHz	32.768 kHz oscillator	0	~~X4~~												
WL-1-2P	Jumper	1	JP3												
WL-1-3P	Jumper	2	JP1	JP2											

Appendix 6 ANT4030_02_0505_B0_L Design Data

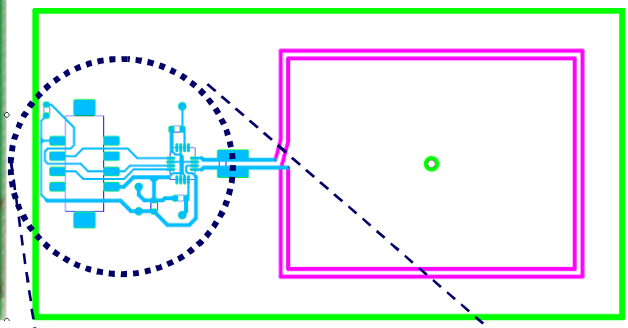
This section summarizes the design data for the antenna board that is used for NFC tag in this document.

The board is also used for a demonstration board provided by us.

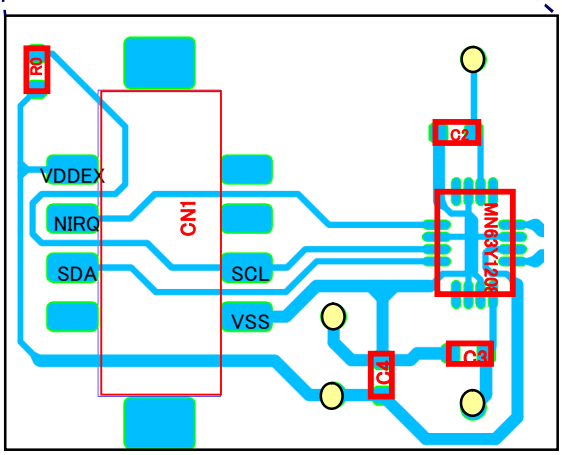
Photograph



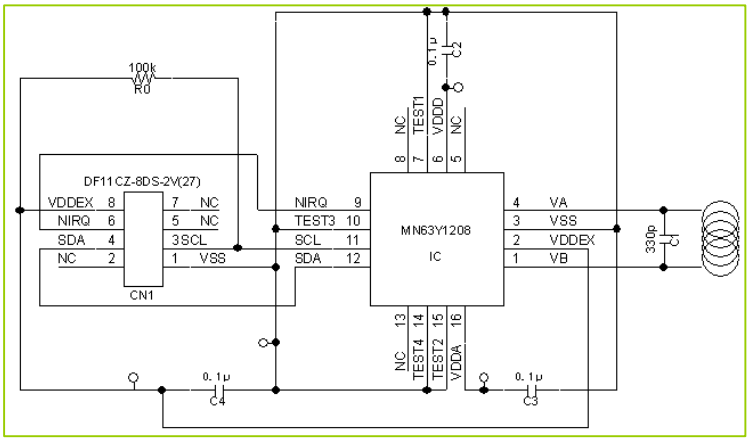
Pattern Diagram



Enlarged



Circuit Diagram



Parts List

Part No.	Description	Count	Value			
MN63Y1208	NFC tag LSI	1	-	IC		
HRS DF11CZ-8DP-2V(27)	Connector	1		CN1		
GRM188R71E104KA01D	Power supply stabilization capacitor	3	0.1 μF	C2	C3	C4
GRM188R71H331KA01D	Resonance adjustment Capacitor	1	330 pF	C1		
RK73B1JTTP104J	SCL pullup resistor	1	100 kΩ	R0		

Appendix 7 List of related documents and hardware

The following documents and hardware are provided to help you to evaluate the NFC-tag LSI and implement it into your system.

Overview and LSI standards

Name	Type	Description	Corresponding LSI
NFC-TAG_Application_note_V*.pdf	Document	This document. Introduction guide for the NFC-tag LSI.	MN63Y1208 / MN63Y1210
AntennaDesignGuide_NFCTAG_V*.pdf	Document	Guideline for antenna design with the NFC-tag LSI	
MN63Y1208-E1_USER_MANUAL_V*.pdf	Document	Product specifications, and functional description manual for LSI.	MN63Y1208
MN63Y1208-E1_ADMIN_MANUAL_NDA_V*.pdf MN63Y1208-E1_ADMIN_MANUAL_nonNDA_V*.pdf	Document	For nonNDA: Manual for setting the system area for LSI. For NDA : Furthermore, the explanation of the cipher function for LSI.	
MN63Y1208-E1_Product_Standard_Ver*.pdf	Document	Electrical characteristics for LSI.	
MN63Y1210-E1_ADMIN_MANUAL_V*.pdf	Document	Product specifications, and functional description manual for LSI.	MN63Y1210
MN63Y1210-E1_ADMIN_MANUAL	Document	Manual for setting the system area for LSI.	
MN63Y1210-E1_Product_Standard_Ver*.pdf	Document	Electrical characteristics for LSI.	

Demonstration and Evaluation

Name	Type	Description	Corresponding LSI
Development_kit_Installation_Manual_v200(E)	Document	Panasonic NFC-tag Development kit Installation Manual	MN63Y1208/ MN63Y1210
Android_Application_User_Manual(E)_v200.pdf	Document	Application User Manual for Android smartphone	
NFCTAG_DumpTool_v200.exe	Software	Demo software to control BTPB-101B for Windows PC	
Panasonic_TagFileTx_v113.apk	Software	Demo software for Tunnel Mode and Handover for Android smartphone	
Panasonic_TagReaderWriterFBRT_v102.apk	Software	Demo software to access to the NFC tag for Android smartphone	
Panasonic_TagSetting1208_v100.apk	Software	Demo software to set MN63Y1208 for Android smartphone	MN63Y1208
Panasonic_TagSetting1210_v100.apk	Software	Demo software to set MN63Y1210 for Android smartphone	MN63Y1210

SDK(Software Development Kit) NDA needed

Name	Type	Description	Corresponding LSI
Android Sample Software Module Specification_V*(E).pdf **(NDA)**	Document	Manual for sample programs to control MN63Y1208 for Android smartphone	MN63Y1208/ MN63Y1210
Panasonic_TagTestApp_Sample01_v***.lzh **(NDA)**	Program	Sample programs to control MN63Y1208 for Android smartphone	
MN63Y1208_Module Specification_v***(E).pdf **(NDA)**	Document	Manual for microcontroller sample programs to control MN63Y1208	MN63Y1208
MN63Y1208 MCU Sample Ve***.lzh **(NDA)**	Program	Microcontroller sample programs to control MN63Y1208	
MN63Y1210_Module Specification_v***(E).pdf **(NDA)**	Document	Manual for microcontroller sample programs to control MN63Y1210	MN63Y1210
MN63Y1210 MCU Sample Ver***.lzh **(NDA)**	Program	Microcontroller sample programs to control MN63Y1210	

Hardware

Name	Type	Description	Corresponding LSI
MN63Y1208-E1	Hardware	Sample LSI for NFC tag (MN63Y1208)	MN63Y1208
MN63Y1210-E1	Hardware	Sample LSI for NFC tag (MN63Y1210)	MN63Y1210
BTPB-101B(V200)	Hardware	Hardware board of host controller for demo and evaluation (With on-board MN101EF63G)	MN63Y1208/1210
NFC-TAG-WS2840	Hardware	Hardware board of NFC-tag for demo and evaluation (Antenna module)	MN63Y1009
NFC-TAG-MN63Y1210	Hardware	Hardware board of NFC-tag for demo and evaluation (Antenna module)	MN63Y1210
ANT4030_02_0505_B0_L	Hardware	Hardware board of NFC-tag for demo and evaluation (Antenna module)	MN63Y1208

Revision History

No.	Date	Version	Comment
1	Oct. 31, 2012	1.00	Initial edition
2	Nov. 21, 2012	1.10	Added the information about MN63Y1210
3	Dec. 19, 2012	1.20	Added operation examples (Chapter 5)
4	Jan. 28, 2013	1.21	Modified the (Appendix 7)
5	Aug. 08, 2013	1.40	Modified “Response to WRITE” value “PCB” and “CRC” Modified “Response to READ” value “PCB” and “CRC”

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